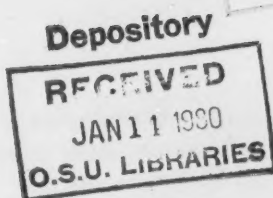


*mai*



SELECTED  
 **WATER  
RESOURCES  
ABSTRACTS**



VOLUME 13, NUMBER 1  
JANUARY 1, 1980

W80-00001 -- W80-00400  
CODEN: SWRABW

TC1  
545  
v.13

121  
44

# **SELECTED WATER RESOURCES ABSTRACTS**

A semimonthly publication of the  
Office of Water Research and Technology  
U.S. Department of the Interior



**VOLUME 13, NUMBER 1  
JANUARY 1, 1980**

W80-00001 -- W80-00400

The Secretary of the U.S. Department of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1983.

TCI  
545  
V.13  
NO.1-4

**A**s the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

## FOREWORD

**S**electing Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographic citation and a set of identifiers or descriptors which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

**Selecting Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of

several planned services of the Office of Water Research and Technology.

To provide SWRA with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

The input from these Centers, and from the 54 Water Resources Research Institutes administered under the Water Research and Development Act of 1978, as well as input from the grantees and contractors of the Office of Water Research and Technology and other Federal water resource agencies becomes the information base from which this journal is derived.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology  
U.S. Department of the Interior  
Washington, D.C. 20240

# CONTENTS

FOREWORD .....	iii
----------------	-----

## SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

### 01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

### 02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

### 03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

### 04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

### 05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

### 06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

### 07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

### 08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

### 09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

### 10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

## SUBJECT INDEX

## AUTHOR INDEX

## ORGANIZATIONAL INDEX

## ACCESSION NUMBER INDEX

## ABSTRACT SOURCES

1. N

1A. 1

WATER  
Geology  
source  
M. J. F.  
Analy  
317R-3

Descri  
orator  
compo  
chemi  
nation  
identif

A liter  
period  
presen  
of alk  
Mn, A  
Mo, V  
Ge, T  
pound  
condu  
deman  
deterg  
stances  
bibliog  
includ  
W80-0

SOME  
DONG  
BROOK  
SION  
Geology  
source  
L. J. T.  
The P  
241-26

Descri  
\*Aqua  
tomolo  
vironn  
River,  
Diam  
tanyu

Benth  
August  
tion in  
nets, a  
sampli  
aquatic  
ed to  
were  
Dipter  
spicuo  
river  
the A  
sinae  
Syndi  
ypus,  
of the  
illustr  
charac  
W80-0

CORE  
PROP  
THER  
GULF  
Geology  
source  
Y. K.  
Paper  
Sympo  
held in  
ety of  
1979.

Descri  
try, \*T  
cal an  
Coasts

# SELECTED WATER RESOURCES ABSTRACTS

## 1. NATURE OF WATER

### 1A. Properties

#### WATER ANALYSIS,

Geological Survey, Lakewood, CO. Water Resources Div.  
M. J. Fishman, and D. E. Erdmann.  
Analytical Chemistry Reviews, Vol. 51, No. 5, p 317R-341R, April 1979. 546 ref.

Descriptors: \*Reviews, \*Chemical analysis, \*Laboratory tests, \*Analytical techniques, Inorganic compounds, Organic compounds, Gases, Radiochemical analysis, Isotopes, Instrumentation, Automation, Spectrometers, Measurement, Pollutant identification, Bibliographies.

A literature review covering water analysis for the period October 1976 through September 1978 is presented. The areas reviewed are determinations of alkali metals, hardness, alkaline-earth metals, Fe, Mn, Al, Cr, Cu, Zn, Pb, Cd, Ni, Co, Bi, Hg, Au, Mo, V, W, U, Th, Ti, Ce, B, P, SiO<sub>2</sub>, Se, As, Sb, Ge, Te, Cl, Br, F, I, S, S<sub>2</sub>, NO<sub>3</sub>, NO<sub>2</sub>, N compounds, alkalinity, carbon dioxide, pH, specific conductance, biochemical and chemical oxygen demand, total carbon, oxygen and other gases, detergents, pesticides, herbicides, organic substances, and radioactivity and isotopic analysis. A bibliography containing 538 literature citations is included. (Woodard-USGS)  
W80-00217

#### SOME LARVAE OF DIAMESINAE AND PODODOMINAE, CHIRONOMIDAE FROM THE BROOKS RANGE, ALASKA, WITH PROVISIONAL KEY,

Geological Survey, Menlo Park, CA. Water Resources Div.  
L. J. Tilley.  
The Pan-Pacific Entomologist, Vol. 54, No. 4, p 241-260, October 1978. 14 fig, 22 ref.

Descriptors: \*Baseline studies, \*Benthic fauna, \*Aquatic insects, \*Arctic, \*Streams, Diptera, Entomology, Larvae, Midges, Systematics, Lotic environment, Alaska, \*Brooks Range, \*Dietrich River, \*Atigun River, Diamessinae, Podonominae, Diamessa, Pseudokiefferiella, Syndiamessa, Trichotanyus.

Benthic invertebrate samples were collected in August 1971 before road and oil pipeline construction in the Brooks Range, Alaska. Drift nets, dip nets, and rock scrubbing procedures were used in sampling. Because little is known about species of aquatic Arctic insects, this report, in part, is intended to fill some of that void. All the samples taken were dominated by midge larvae (Chironomidae: Diptera). The subfamily Diamessinae was most conspicuous in samples taken at the headwaters of two river basins, the Dietrich River flowing south and the Atigun River flowing north. Eleven Diamessinae taxa, 9 Diamessa, 1 Pseudokiefferiella and 1 Syndiamessa, and a single Podonominae, Trichotanyus, were found. Principle morphological features of the larvae of each taxon are described and illustrated; and a key, based on 6 or 7 larval characteristics, is included. (Woodard-USGS)  
W80-00218

#### CORROSION AND SCALE-FORMATION PROPERTIES OF GEOPRESSURED GEOTHERMAL WATERS FROM THE NORTHERN GULF OF MEXICO BASIN,

Geological Survey, Menlo Park, CA. Water Resources Div.  
Y. K. Kharaka, P. M. Brown, and M. S. Lico.  
Paper SPE 7866 presented at the International Symposium on Oilfield and Geothermal Chemistry held in Houston, Texas, January 22-24, 1979. Society of Petroleum Engineers of AIME, p 55-58, 1979. 1 fig, 2 tab, 20 ref.

Descriptors: \*Geothermal studies, \*Water chemistry, \*Thermal water, \*Corrosion, \*Scaling, Chemical analysis, Connate water, Texas, Louisiana, Coasts, Oil field, \*Geopressured waters.

Corrosion and scale-formation properties of geopressured geothermal waters are expected to be different from those of waters having similar chemical composition but produced from oil and gas wells. The differences result because (1) geopressured geothermal waters will be at much higher temperatures (generally > 120 C), (2) the volumes of water produced per well will be much higher, and (3) oil will be absent from these waters. Detailed chemical analyses of 120 formation-water samples from 25 oil and gas fields in coastal Texas and Louisiana show that the dissolved solids of water in the geopressured zones ranges from about 10,000 to 270,000 mg/L. Na and Cl generally constitute more than 90 percent of the total cations and anions, respectively. The high salinities, Cl concentrations, and temperatures increase the corrosivity of geopressured geothermal waters by facilitating dissolution of iron at anodic sites. The corrosivity of these waters, however, will probably be controlled by reactions at cathodic sites. Cathodic reactions apparently will be slow because of the almost complete absence of dissolved oxygen, absence of sulfate-reducing bacteria (high temperatures), and low variation of pH (about 6 to 8). Corrosion due to H<sub>2</sub>S will be minimal because the concentrations of H<sub>2</sub>S are less than 1 mg/L. Computing the states of reactions of these waters with respect to 165 minerals indicate that oxyhydroxides of iron, carbonates of Ca, Sr, and Ba, and sulfate of Ba may precipitate from the waters during production. (Woodard-USGS)  
W80-00219

#### HYDROLOGIC RECONNAISSANCE OF WESTERN ARCTIC ALASKA, 1976 AND 1977,

Geological Survey, Anchorage, AK. Water Resources Div.  
J. M. Childers, D. R. Kernodle, and R. M. Loeffler.  
Geological Survey open-file report 79-699, 1979. 70 p, 32 fig, 6 tab, 14 ref.

Descriptors: \*Hydrologic data, \*Water resources, \*Surface waters, \*Springs, \*Alaska, Arctic, Streamflow, Discharge(Water), Lakes, Physical properties, Chemical properties, Ice cover, Water levels, Specific conductivity, Water temperature, Dissolved oxygen, Turbidity, Color, Hardness(Water), Hydrogen ion concentration, Potassium, Sodium, Carbon dioxide, Sulfates, Chlorides, Fluorides, Silica, Invertebrates, Flood flow, Low flow, Baseline studies, \*Oil and gas discoveries, \*Western Arctic Alaska.

Reconnaissance water-resource investigations were conducted on the western Alaskan Arctic Slope during April 1976 and August 1977; these months are times of winter and summer low flow. The information gathered is important for coordinated development in the area. Such development has been spurred by oil and gas discoveries on the North Slope, most notably at Prudhoe Bay. Little water resources information is currently available. The study area extended from the Colville River to the vicinity of Kotzebue. It included the western Arctic Slope and the western foothills of the Brooks Range. Nine springs, nine lakes and eleven rivers were sampled during the April 1976 reconnaissance trip. Its purpose was to locate winter flow and describe its quantity and quality. Field water-quality measurements made at these sites were: ice thickness, water depth, discharge (spring and streams), specific conductance, water temperature, dissolved oxygen, alkalinity (bicarbonate, HOC3), and pH. A followup summer trip was made in August 1977 to determine flood characteristics of twenty selected streams. Bankfull and maximum evident flood-peak discharges were determined by measuring channel geometry and estimating channel roughness. Aquatic invertebrate samples were collected at springs and flood survey sites visited during both reconnaissance trips. (Woodard-USGS)  
W80-00223

## 1B. Aqueous Solutions and Suspensions

#### AZOMETHINE H COLORIMETRIC METHOD FOR DETERMINING DISSOLVED BORON IN WATER,

Geological Survey, Denver, CO. Water Resources Div.  
R. R. Spencer, and D. E. Erdmann.  
Environmental Science and Technology, Vol. 13, No. 8, p 954-956, August 1979. 2 fig, 3 tab, 5 ref.

Descriptors: \*Water analysis, \*Chemical analysis, \*Boron, \*Analytical techniques, \*Trace elements, Laboratory tests, \*Azomethine H colorimetric method.

An automated colorimetric method for determining dissolved boron in water is described. The boron is complexed with azomethine H which is readily available as the condensation product of H-acid (8-amino-1-naphthol-3,6-disulfonic acid) and salicylaldehyde. The absorbance of the yellow complex formed is then measured colorimetrically at 410 nm. Interference effects from other dissolved species are minimized by the addition of diethylenetriamine pentaacetic acid (DTPA); however iron, zinc, and bicarbonate interfere at concentrations above 400 micrograms per liter, 2,000 micrograms per liter, and 200 milligrams per liter, respectively. The bicarbonate interference can be eliminated by careful acidification of the sample with concentrated HCl to a pH between 5 and 6. Thirty samples per hour can be routinely analyzed over the range of from 10 to 400 micrograms per liter boron. (Woodard-USGS)  
W80-00221

## 2. WATER CYCLE

### 2A. General

#### WATER RECOVERY DEVICE,

J. F. Clark.  
U.S. Patent No. 4,148,617, 4 p, 1 fig, 9 ref; Official Gazette of the United States Patent Office, Vol. 981, No. 2, p 571, April 10, 1979.

Descriptors: \*Patents, \*Meteoric water, \*Water vapor, Condensation, Moisture, Equipment.

A device is disclosed for recovering water from ambient air. It has two chambers in one of which a pressurized air stream is heated and in the other of which another pressurized air stream is cooled after which the two air streams are mixed resulting in condensation of the moisture contained in the air streams which is then collected and put to use. (Sinha-OEIS)  
W80-00030

#### ASSESSMENT OF WATER QUALITY SIMULATION CAPABILITY FOR LAKE ONTARIO, Canada Centre for Inland Waters, Burlington (Ontario).

F. M. Boyce, A. S. Fraser, E. Halfon, D. Hyde, and D. C. L. Lam.  
Scientific Series No. 111, 1979, 220 p, 66 fig, 55 tab, 110 ref.

Descriptors: \*Water quality, \*Model studies, \*Seasonal, \*Variability, \*Analysis, Data collections, Sedimentation, Nutrients, Biochemistry, \*Lake Ontario, \*Spatial variations.

This report evaluates the ability of current water quality models to simulate seasonal variations, long-term trends, and spatial variations in Lake Ontario. The analysis relies on routine surveillance data collected during the last decade and especially on observations taken during the International Field Year on the Great Lakes (IFYGL). The model evaluations concentrate on conceptual frameworks rather than mathematical formulations. By fitting dynamic models to a seasonal database, it is shown that equally satisfactory simulations can be obtained by a variety of parameterizations and regardless of conditions of annual peri-

## Field 2—WATER CYCLE

### Group 2A—General

odicity. By comparison of model output with long-term observations, it is demonstrated that such seasonal verification studies are of little use in diagnosing the utility of these models for predicting long-term trends. It is concluded that the uncertainty surrounding the formulation of sedimentation and nutrient regeneration, as well as the sensitivity of models to assumptions regarding dynamic balance between lake concentrations and nutrient loadings, undermine the predictive capability of dynamic water quality models. With regard to spatial variations, it is concluded that the lakewide response can be simulated reasonably well by simplified horizontally mixed models but that three-dimensional models are necessary to simulate the very important differences in biochemical properties between nearshore and offshore zones. (WATDOC)  
W80-00199

**WATER QUALITY SOURCEBOOK. A GUIDE TO WATER QUALITY PARAMETERS.** Department of the Environment, Ottawa (Ontario). Water Quality Branch.  
R. N. McNeely, V. P. Neimann, and L. Dwyer. 1979, 89 p, 6 fig, 8 tab, 38 ref, 1 append.

Descriptors: \*Water quality, \*Water quality standards, \*Parametric hydrology, \*Metals, Alkalinity, Hardness(Water), Oxygen, Pesticides, Hydrogen ion concentration, Surfactants, Polychlorinated biphenyls, Temperature, Turbidity, Fish, Halides, Bacteria.

A broad spectrum of water quality parameters that are frequently encountered in the aquatic environment are discussed in general terms. Seventy parameters ranging from alkalinity to zinc are outlined under the following headings: (a) general information, (b) environmental range, (c) natural and man-made sources, (d) water quality guidelines, and (e) effects on use. A glossary is included to further explain the scientific terminology which is essential to the text. An appendix of 'Specific Use Guidelines' draws together and summarizes in a tabular form all the water quality guidelines presented in the text. The sources of the water quality guidelines are cited in the tables and are available in the references to the text. (WATDOC)  
W80-00200

**COMPARING WATER SUPPLY FORECAST TECHNIQUES.** Science and Education Administration, Boise, ID. Northwest Watershed Research Center.  
J. F. Zuzel, and W. T. Ondrechen.  
In: Watershed Management. Proceedings of a Symposium conducted by the Irrigation and Drainage Division of the American Society of Civil Engineers, Logan, Utah, August, 1975, p 327-336, 1975. 1 fig, 6 tab, 9 ref. ASCE, New York, NY.

Descriptors: \*Water supply, \*Forecasting, \*Model studies, \*Snowmelt, \*Boise River(Idaho), Statistical methods, Regression analysis, Optimization, Runoff, Accuracy, Watersheds(Basins), Multipurpose reservoirs, Equations, Systems analysis.

Accurately forecasting the quantity of snowmelt runoff is a minimum operational requirement of any multipurpose reservoir system. All water supply forecast models provide volume information which often differ greatly. Examined herein are three of these models and a fourth model in an effort to arrive at a single 'best' forecast model for the Boise River in Idaho. The multiple regression models used by the Bureau of Reclamation, Corps of Engineers, and Soil Conservation Service to forecast runoff volume on the Boise River have several disadvantages, with reduced accuracy in early forecasts and in high and low runoff years being two of the most serious. The ARS-IDWR model somewhat overcomes many disadvantages associated with the multiple regression models; the method is versatile, easily applied, and a separate optimization can be performed for each forecast date. It is concluded that the daily streamflow model will not replace the long-term volume forecast model for some time to come.  
W80-00202

**MODELING MANAGEMENT OF PONDEROSA PINE FOREST RESOURCES.** Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.  
M. B. Baker, Jr.  
In: Watershed Management. Proceedings of a Symposium conducted by the Irrigation and Drainage Division of the American Society of Civil Engineers, Logan, Utah, August, 1975, p 478-493, 1975. 9 fig, 4 tab, 7 ref. ASCE, New York, N.Y.

Descriptors: \*Forest management, \*Ponderosa pine trees, \*Forest watersheds, \*Water yield, \*Effects, \*Vegetation changes, Precipitation, Streamflow, \*Treatment, Winter, Summer, Basal area, Arizona, Basins, Mathematical models, Regression analysis, Evaluation, Timber, Wildlife, Forage, Alternative planning, Economic analysis, Volcanic soils, Systems analysis.

In the middle 1950's, water users and ranchers urged the treatment of watersheds in Arizona's Salt-Verde Basin to increase water yields for irrigation and to provide more grass for grazing. In response, the Forest Service initiated watershed management studies to evaluate the effects of vegetation changes on water yield, soil, forage, wildlife and recreation. This paper reports on a study of the Beaver Creek Watershed during 1957 to 1962. The focus is on water yield; however timber, wildlife and forage are also considered. The article discusses: (1) treatment tests, including the distribution of precipitation and streamflow; (2) water responses, including the effects of treatments on winter streamflow in inches from pine watersheds, a preliminary water yield model, and summer sediment yield predicted by regression analysis; (3) responses of other resources; (4) evaluating planning and management alternatives; and finally (5) an economic evaluation of the ponderosa pine zone of the Salt-Verde River basin. Five principle conclusions are drawn concerning resource responses resulting from manipulating ponderosa pine forests on volcanic soils. (Bell-Graf-Cornell)  
W80-00228

**TWO-DIMENSIONAL AND THREE-DIMENSIONAL DIGITAL FLOW MODELS FOR THE SALINAS VALLEY GROUND-WATER BASIN, CALIFORNIA.** Geological Survey, Menlo Park, CA. Water Resources Div.  
T. J. Durbin, G. W. Kappale, and J. R. Freckleton.  
Geological Survey Water-Resources Investigations 78-113, November 1978. 134 p, 70 fig, 14 tab, 78 ref.

Descriptors: \*Groundwater basins, \*Groundwater movement, \*Model studies, \*Mathematical models, \*Dimensional analysis, Surface-groundwater relationships, Rainfall-runoff relationships, Hydrogeology, Water level fluctuations, Withdrawal, Groundwater recharge, Aquifer characteristics, Maps, \*Salinas Valley(CA).

The Salinas Valley ground-water basin is in central coastal California. The ground-water basin extends from Monterey Bay southeastward along the Salinas River to San Ardo, a distance of about 70 miles, and has a maximum thickness of about 2,000 feet. Annual recharge to the ground-water basin, which is derived mostly from the Salinas River, is about 290,000 acre-feet. Annual discharge, which is mostly from pumpage but also includes the consumptive use of ground water by riparian vegetation along the Salinas River, is about 507,000 acre-feet. About 45 percent of the pumpage, or about 217,000 acre-feet of water annually, returns to the ground-water system. A system of interacting hydrologic models was developed for the Salinas Valley. These models include the small-stream model, river model, two-dimensional ground-water model, and three-dimensional ground-water model. The small-stream model simulates ground-water recharge from small streams that are tributary to the Salinas River. The river model simulates ground-water recharge from the surface-water discharge in the Salinas River. The two-dimensional and three-dimensional ground-water models simulate hydraulic head in the ground-water basin. (Woodard-USGS)

W80-00238

**CONTRIBUTION OF URBAN RUNOFF TO HYDROCARBON POLLUTION.** Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences.  
For primary bibliographic entry see Field 5B.  
W80-00357

### 2B. Precipitation

**POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE PESTICIDES IN GREAT LAKES PRECIPITATION.** Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 5A.  
W80-00086

**SYSTEMATIC SAMPLING OF GAUSSIAN RANDOM PROCESSES AND FIELDS.** Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2F.  
W80-00089

**A STOCHASTIC KINEMATIC STUDY OF SUBSYNOPTIC SPACE-TIME RAINFALL.** Mississippi Univ., University. Dept. of Civil Engineering.  
V. K. Gupta, and E. C. Waymire.  
Water Resources Research, Vol. 15, No. 3, p 637-644, June 1979. 1 fig, 20 ref. NSF ENG76-08998, ENG78-05147.

Descriptors: \*Rainfall, \*Spatial distribution, \*Temporal distribution, \*Model studies, Mathematical models, Precipitation(Atmospheric), Rainfall intensity, Mathematics, Equations, Stochastic processes, Analytical techniques, Meteorology.

A kinematic stochastic approach to quantify the ground rainfall intensity field due to the passage of a large mesoscale area (LMSA) was presented. The theoretical developments were based on 4 postulates on the components of an LMSA. The 4 postulates incorporate the spatial clustering that the rainfall cells have been observed to exhibit. These postulates lead to a representation of the rainfall field as a stochastic integral. An analysis of the structure of this integral revealed two auxiliary stochastic fields embedded within it. Not only do each of these admit an independent physical interpretation, but their analysis is a precursor to the analysis of the space-time rainfall field. Some results on the space-time dependence structure of the auxiliary fields were presented. As an application of these results, expressions were derived for the mean, variance, and the one-dimensional characteristic function of rainfall intensity. A part of the mathematical construct also provided algorithms which can be used for simulating space-time rainfall. (Sims-ISWS)  
W80-00092

**SUBSTRATE CONDITIONS, COMMUNITY STRUCTURE AND SUCCESSION IN A PORTION OF THE FLOODPLAIN OF WISSAHICKON CREEK.** S. C. Sollers.  
Bartonia, No. 42, p 24-42, 1973-1974. 4 fig, 3 tab, 17 ref.

Descriptors: \*Soil types, \*Soil water movement, \*Floodplains, \*Allogenic succession, \*Autogenic succession, \*Biological communities, Hydrogen ion concentration, Nutrients.

Interrelationships among substrate conditions, community structure, and succession in Wissahickon Creek floodplain of Pennsylvania were analyzed. Nutrient concentrations are moderate in shallow, moderately well-drained soils and deficient in deep, well-drained soils. Silt loam is found in swamp white oak, oak-hickory, ash-walnut, and oak-beech communities; loamy soils in sycamore, yellow poplar and locust-maple communities; and

## Snow, Ice, and Frost—Group 2C

## 2C. Snow, Ice, and Frost

W80-00336

## OPERATIONAL USE OF DIGITAL RADAR IN RAINFALL MEASUREMENT AND PREDICTION

National Weather Service, Silver Spring, MD.  
Office of Hydrology.  
For primary bibliographic entry see Field 7B.  
W80-00337

## FIELD PROJECTS EXECUTED BY WMO ON FLOOD FORECASTING AND WARNING, USING RADAR AND/OR INTEGRATED TELEMETRY SYSTEMS.

World Meteorological Organization, Geneva (Switzerland).  
For primary bibliographic entry see Field 2E.  
W80-00338

## EFFECTS OF ACIDIC PRECIPITATION ON PRECAMBRIAN FRESHWATERS IN SOUTHERN ONTARIO

Ontario Ministry of the Environment, Rexdale.  
Limnology and Toxicity Section.  
For primary bibliographic entry see Field 5A.  
W80-00344

## SURFACE LOADING FROM POLLUTANTS IN PRECIPITATION IN SOUTHERN ONTARIO: SOME CLIMATIC AND STATISTICAL ASPECTS

Windsor Univ. (Ontario). Dept. of Geography.  
For primary bibliographic entry see Field 5A.  
W80-00345

## RIDGE REGRESSION—TIME EXTRAPOLATION APPLIED TO HAWAIIAN RAINFALL NORMALS

Hawaii Univ., Honolulu. Joint Inst. for Marine and Atmospheric Research.  
B. N. Meisner.  
Journal of Applied Meteorology, Vol. 18, No. 7, p 904-912, July 1979. 2 fig, 3 tab, 43 ref, 1 append.  
NOAA 03-7-028-31000.

Descriptors: \*Rainfall, \*Data processing, \*Analytical techniques, \*Hawaii, Regression analysis, Meteorological data, Climatic data, Data processing, Mathematics, Statistics, Mapping, Climatology, \*Oahu(HI), Ridge regression.

In this paper, ridge regression was introduced as a technique for extrapolating long-period normal rainfalls from short records. The data used were the annual totals for selected stations on the island of Oahu, Hawaii. It was shown that when the predictor variables are not mutually independent, as is often the case in meteorology, it is unlikely that the estimates of the coefficients obtained through unbiased multiple linear regression will be close to the correct values. In such cases, a method of biased estimation, such as the so-called ridge regression, will yield more accurate estimates of the true regression coefficients. Ridge regression was shown to be superior to ordinary least-squares regression and double-mass analysis, and was a robust estimator of central tendency for extrapolating Hawaiian rainfall normals. Mention was also made on the choice of normal statistic and on the selection of the base period of record. Since there is such a diversity of both topographic and climatological regions on Oahu Island, it is expected that this method should be applicable in many other locales. Furthermore, the method is not limited to rainfall data; statistical relationships among other meteorological variables, such as model output statistics, may be similarly determined using this technique. (Sims-ISWS)  
W80-00350

## ACIDIFICATION OF HEADWATER STREAMS IN THE NEW JERSEY PINE BARRENS

Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture.  
For primary bibliographic entry see Field 5B.  
W80-00354

sandy loams in white pine. Norway maple prefers moisture and potassium. Slippery elm favors sites with rich alkaline soils high in organic matter. Shellbark hickory prefers rich soils, and is tolerant of hydrogen ion concentration variations. Red maple favors bottomland soils with a high water table. Northern red oak prefers moist, slightly acidic conditions, and tolerates low nutrient conditions. American beech favors well-drained loam soils. White oak tolerates nutritionally poor soils of oak-beech but does better in richer oak-hickory. Flowering dogwood tolerates poor soils; sycamore favors well-drained, enriched soils; yellow poplar alkaline, high nutrient soils. White ash success is independent of organic matter. Blackhaw indicates slightly acidic, rich soils. A change in soil conditions has a greater effect on seedlings than mature specimens. Physical factors controlled by the stream dominate the initial stages of succession, with biotic factors dominating later. (Otello-Mass)  
W80-00310

## BIOGEOCHEMISTRY OF A FORESTED ECOSYSTEM

Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.  
For primary bibliographic entry see Field 4C.  
W80-00328

## RAINFALL MEASUREMENT BY RADAR, British Meteorological Office, Bracknell (England)

For primary bibliographic entry see Field 7B.  
W80-00329

## A SYSTEM FOR REAL-TIME PROCESSING TRANSMISSION AND DISPLAY OF RADAR-DERIVED RAINFALL DATA

Royal Radar Establishment, Malvern (England).  
For primary bibliographic entry see Field 7B.  
W80-00330

## DESIGN OF THE DEE TELEMETRY SYSTEM WITH COMPUTER ACQUISITION OF DATA

Water Resources Board, Reading (England).  
For primary bibliographic entry see Field 7B.  
W80-00331

## INSTALLATION AND OPERATION OF THE DEE TELEMETRY SYSTEM

Welsh National Water Development Authority, Cardiff (Wales).  
For primary bibliographic entry see Field 7B.  
W80-00332

## CAPITAL AND OPERATING COSTS OF THE EXISTING DEE RADAR, TELEMETRY AND FLOW FORECASTING PROJECT

Water Resources Board, Reading (England).  
For primary bibliographic entry see Field 7B.  
W80-00333

## RAINFALL FORECASTS IN THE UNITED KINGDOM USING RADAR DATA

British Meteorological Office, Bracknell (England).  
T. W. Harrold.  
Paper 8, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 21 p, 7 fig, 1 tab, 12 ref.

Descriptors: \*Rainfall, \*Forecasting, \*Radar, Precipitation(Atmospheric), Mathematical models, Data processing, Remote sensing, Watersheds(Basins), Weather, Climatology, Meteorology, \*England, \*Wales, \*River Dee.

Weather radars are used in the United Kingdom for both operational and research purposes. The operational radars indicate rainfall distribution, but they are not capable of making quantitative rainfall measurements. Data from the research radars were used in this paper to demonstrate that much more ambitious forecasts could be attempted if there were a network of radars capable of quantitative measurement covering the country. (Sims-ISWS)

EFFECT OF THE PERCENTAGE AND DISTRIBUTION OF FORESTED AREAS ON SNOWMELT RUNOFF (EFFET DU POURCENTAGE ET DE LA DISTRIBUTION DES SURFACES BOISEES SUR LES CRUES DE FONTE DE NEIGE), National Inst. of Scientific Research (Quebec).  
R. Charbonneau, G. Morin, and J. P. Fortin.  
Journal of Hydrology, Vol. 41, No. 1/2, p 93-103, April 1979. 3 fig, 1 tab, 27 ref.

Descriptors: \*Model studies, \*Forest management, \*Water yield, \*Simulation analysis, \*Snowmelt, Runoff, Mathematical models, River basins, Hydrology, Floods, \*Deforestation, \*Kenogami watershed, Redistribution.

A mathematical model was developed to simulate the effect of a variation in forest cover on snowmelt runoff. The variation can be in the percentage of forested area as well as in the distribution of these areas. The simulations can provide important data for basin management. The model was applied to basins exceeding 3,000 sq km, and the results clearly indicated the possibility of modifying the snowmelt synchronization between different parts of a basin by changing the distribution and/or percentage of its forest cover. (Singh-ISWS)  
W80-00072

## DIRECT OBSERVATIONS OF AEROSOLS ATTACHED TO FALLING SNOW CRYSTALS

Hokkaido Univ., Sapporo (Japan). Dept. of Geophysics.  
C. Magono, T. Endoh, F. Ueno, S. Kubota, and M. Itasaka.  
Tellus, Vol. 31, No. 2, p 102-114, April 1979. 6 fig, 1 tab, 15 ref.

Descriptors: \*Snow, \*Aerosols, \*Fallout, \*Water pollution sources, Sampling, Analytical techniques, Analysis, Crystals, Testing procedures, Instrumentation, Foreign research, Microscopy, Size, Distribution, On-site investigations, \*Japan.

Aerosols attached to falling snow crystals were directly observed utilizing optical and electron microscopes in Sapporo, Japan, in March 1973 and 1974. It was determined that the aerosols were picked up by snow crystals during their fall under the cloud base. Because the slope of size distribution of aerosols attached to snow crystals was nearly the same as Junge distribution in the range 0.1 to 5 microns, it was considered that falling snow crystals captured aerosols with a collection efficiency almost similar to neighboring size ranges against the general theory of collection efficiency. The collection efficiency was also calculated by the use of surface density of aerosols attached to the surface of snow crystals. The results of calculations showed that the apparent collection efficiency was as high as near unity. In order to explain such high efficiency, many possible mechanisms, e.g., impact collision, Facy effect, diffusion (Brownian motion and turbulent motion), and electrostatic force were theoretically estimated. However, these mechanisms were insufficient to explain the high collective efficiency. This suggests that there are some unknown mechanisms remaining in the natural washout of aerosols by falling snow crystals. (Humphreys-ISWS)  
W80-00080

## A DYNAMIC THERMODYNAMIC SEA ICE MODEL

Army Terrestrial Sciences Center, Hanover, NH.  
W. D. Hibler, III.  
Journal of Physical Oceanography, Vol. 9, No. 4, p 815-846, July 1979. 26 fig, 4 tab, 52 ref, 3 append.  
NOAA 64-7-022-44017.

Descriptors: \*Sea ice, \*Oceans, \*Arctic, \*Model studies, Mathematical models, Ice, Ice cover, Circulation, Ocean circulation, Freezing, Growth rates, Velocity, Movement, Stress, Viscosity, Oceanography, Cold regions, Ice thickness.

## Field 2—WATER CYCLE

### Group 2C—Snow, Ice, and Frost

A numerical model for the simulation of sea ice circulation and thickness over a seasonal cycle was presented. This model was used to investigate the effects of ice dynamics on Arctic ice thickness and air-sea heat flux characteristics by carrying out several numerical simulations over the entire Arctic Ocean region. The essential idea in the model was to couple the dynamics to the ice thickness characteristics by allowing the ice interaction to become stronger as the ice becomes thicker and/or contains a lower areal percentage of thin ice. The dynamics, in turn, causes high oceanic heat losses in regions of ice divergence and reduced heat losses in regions of convergence. To model these effects consistently, the ice was considered to interact in a plastic manner with the plastic strength chosen to depend on the ice thickness and concentration. The thickness and concentration, in turn, evolve according to continuity equations which include changes in ice mass and percent of open water due to advection, ice deformation, and thermodynamic effects. For the standard experiment, an integration of 8 years in length was performed at one day timesteps and 125 km resolution in order to obtain a cyclic equilibrium. A zero ice strength condition was used at the Greenland-Spitsbergen passage to allow natural outflow or inflow. Several other shorter experiments, including a case without open water effects, were also run for comparison. Input fields consist of observed time varying geostrophic winds over a one year period, fixed geostrophic ocean currents, and geographically invariant ice growth rates dependent on ice thickness and season. (Sims-ISWS) W80-00084

#### SOLAR RADIATION AS INDEXED BY CLOUDS FOR SNOWMELT MODELING, Arizona Univ., Tucson. School of Renewable Natural Resources.

D. P. McAda, and P. F. Ffolliott.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 175-181, 3 fig, 9 ref.

Descriptors: \*Snowmelt, \*Snow management, \*Cloud physics, \*Regression analysis, \*Solar radiation, Melt water, Cloud cover, Atmospheric physics, Model studies, Forecasting, Hydrologic equation, Arizona.

In an effort to improve the methods of forecasting the amount and timing of snowmelt, a primary source of water in Arizona, significant regression equations are developed over a selected measurement period to relate global, direct, and diffuse solar radiation to: (1) the cloud-cover of specific cloud genera, (2) the hour before or after solar noon, and (3) the potential solar radiation. Three regression equations are derived from cloud-cover imagery and solar radiation data collected from two sites in Arizona's Ponderosa pine forests, Schnebly Hill, and Alpine, in the hope that regression models will be useful in the simulation of snowpack dynamics. (Tickes-Arizona) W80-00292

### 2D. Evaporation and Transpiration

THE PRIESTLEY-TAYLOR EVAPORATION MODEL APPLIED TO A LARGE, SHALLOW LAKE IN THE NETHERLANDS, Royal Netherlands Meteorological Inst., De Bilt. H. A. R. de Bruin, and J. Q. Keijman. Journal of Applied Meteorology, Vol. 18, No. 7, p 898-903, July 1979. 5 fig, 1 tab, 16 ref.

Descriptors: \*Evaporation, \*Lakes, \*Shallow water, \*Model studies, Mathematical models, Saturated soils, Drying, Energy budget, Diurnal, Wind, Temperature, Heat flow, On-site investigations, On-site data collections, Meteorological data, \*The Netherlands, \*Lake Flevo(The Netherlands).

The applicability of the model of Priestley and Taylor for evaporation of saturated surfaces was examined for the former Lake Flevo (The Netherlands).

lands). This lake had an area of about 460 sq km and an average depth of 3 m. Daily values of evaporation in the period July-September 1967, determined with the energy-budget method, were compared with the corresponding estimated values obtained by the Priestley-Taylor model. The agreement appeared to be satisfactory. The diurnal variation of the parameter alpha of the Priestley-Taylor model was found to be pronounced. From standard meteorological observations at Oostvaardersdiep, a station at the perimeter of the lake, and an energy-budget model of Keijman, an indirect extension of the available time series was obtained. In this way, energy-budget data for the period April-October 1967 became available. Analysis of this data set led to the preliminary conclusion that alpha has a seasonal variation. This was due to the fact that there is a linear relation between the daily latent heat flux LE and the equilibrium latent heat flux LE sub EQ with a nonzero intercept. (Sims-ISWS) W80-00349

#### HEAT TRANSFER THROUGH THE THERMAL SKIN OF A COOLING POND WITH WAVES, Argonne National Lab., IL.

M. L. Wesely.

Journal of Geophysical Research, Vol. 84, No. C7, p 3696-3700, July 20, 1979. 3 fig, 1 tab, 22 ref.

Descriptors: \*Heat transfer, \*Thermal properties, \*Cooling, Thermal water, Waves(Water), Latent heat, Cooling water, Temperature, Wind velocity, Wind, \*Thermal skin, \*Cooling pond, Temperature drop, Surface temperature, Total heat transfer, Sensible heat flux, Long-wave radiation exchange.

The temperature drop measured across the cool skin of a cooling pond was examined for 64 10-minute data collection periods taken with wind speeds of 3-8.5 m/s (effectively at a height of 10 m) and surface temperatures of 18-37.5 °C. The total heat transfer through the skin was found with the use of bulk aerodynamic estimates of the latent and sensible heat flux densities and empirical expressions for the long-wave radiation exchange at the surface. Although it is questionable to describe the characteristics of a surface with waves by the use of formulas derived partially on the assumption that a rigid boundary exists at the air-water interface, the parameterizations that result seem to perform quite well. For example, values of the numerical proportionality coefficient which relate the total heat transfer to the temperature drop increase slightly from 6 to 7 as water temperature increases; these values are near those reported previously. No variation of proportionality coefficient with wind speed was detected. If the proportionality coefficient is replaced by a numerical coefficient that also takes into account the difference of the thickness of the thermal and viscous sublayers, the new coefficient does not vary significantly with temperature of the surface skin. (Roberts-ISWS) W80-00351

### 2E. Streamflow and Runoff

#### STREAM CHANNEL MODIFICATION IN HAWAII PART A: STATEWIDE INVENTORY OF STREAMS: HABITAT FACTORS AND ASSOCIATED BIOTA, Hawaii Cooperative Fishery Research Unit, Honolulu.

For primary bibliographic entry see Field 6G. W80-00003

#### STREAM CHANNEL MODIFICATION IN HAWAII PART B: EFFECT OF CHANNELIZATION ON THE DISTRIBUTION AND ABUNDANCE OF FAUNA IN SELECTED STREAMS, Hawaii Cooperative Fishery Research Unit, Honolulu.

For primary bibliographic entry see Field 6G. W80-00004

#### THE FLUVIAL SYSTEM: SELECTED OBSERVATIONS,

California Univ., Santa Barbara. Dept. of Geological Sciences. E. A. Keller.

In: Riparian Forests in California: Their Ecology and Conservation, Anne Sands, editor, Institute of Ecology, University of California, Davis, Publication No. 15, May, 1977, p 39-46. 7 fig, 15 ref.

Descriptors: \*Streams, \*Channels, \*Sediments, Effects, Erosion, Deposition(Sediments), Meanders, Gravel, Floodplains, Hydrology, Flow.

Significant changes in the fluvial system often occur when a geomorphic or hydraulic threshold is exceeded. These changes are partly responsible for maintaining the dynamic equilibrium state of the stream system. Human use and interest in the fluvial environment has led to human interference with the fluvial system. The interference generally reduces channel, floodplain and hydraulic variability and thus the biological variability. The behavior of natural streams is not completely understood. Particularly important is the need to know more about relationships between erosion, deposition and sediment concentration, as well as the effect of organic debris on stream channel morphology. (Stihler-Mass) W80-00019

#### FLORISTICS OF THE MIDDLE MISSISSIPPI RIVER SAND AND MUD FLATS, Marshall Univ., Huntington, WV. Dept. of Biological Sciences.

For primary bibliographic entry see Field 2L

W80-00028

#### EMERGENT AQUATIC PLANTS IN THE UPPER OHIO RIVER AND MAJOR NAVIGABLE TRIBUTARIES, WEST VIRGINIA AND PENNSYLVANIA, Army Engineer District, Pittsburgh, PA.

For primary bibliographic entry see Field 2L

W80-00029

#### VELOCITY PROFILES AND MINIMUM STREAM POWER, Minnesota Univ., Minneapolis. Dept. of Civil Engineering.

C. C. S. Song, and C. T. Yang. Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY8, Proceedings Paper 14780, p 981-998, August 1979. 8 fig, 2 ref, 2 append.

Descriptors: \*Viscosity, \*Velocity, \*Streams, Open channels, Open channel flow, Turbulence, Turbulent boundary layer, Flow, Equations, Energy dissipation, Eddies, Reynolds number, Stream power, Velocity distribution.

The velocity distribution of laminar and turbulent flows in a wide open channel was analyzed using the theory of minimum rate of energy expenditure or, equivalently, the theory of minimum stream power. The solution for the laminar flow is the classical parabolic velocity distribution. For turbulent flow it is necessary to assume the functional forms of the velocity distribution and the corresponding eddy viscosity distribution. A number of constants or parameters in the assumed functions were determined using the minimization theory and appropriate constraint equations. By assuming that the turbulent flow may consist of a logarithmic inner layer and a parabolic outer layer, the minimization theory determines that the thicknesses of the two layers must be equal. Two constants remain to be determined using experimental data. It was suggested that the two empirical constants are best determined by measured maximum and mean velocities. Theoretical results were verified with data available in the literature. (Lee-ISWS) W80-00077

#### FLOOD PROFILES OF THE PITHLACHASCO-TEE RIVER, WEST-CENTRAL FLORIDA, Geological Survey, Tallahassee, FL. Water Resources Div.

J. F. Turner, Jr., W. R. Murphy, Jr., and C. V.

## Streamflow and Runoff—Group 2E

Reuter.

Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 107. Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-100, 1979. 22 p, 5 fig, 4 tab, 19 ref.

Descriptors: \*Flood profiles, \*Flood plains, \*Peak discharge, \*Flood flow, \*Flood recurrence interval, Methodology, Hydrologic data, Flood plain zoning, Watersheds(Basins), Drainage area, Physical properties, Geology, Topography, Karst, Florida, \*Pithlachascotee River, \*Pasco County(Fla).

Data defining the magnitude and frequency of flooding are provided for a nontidal 16-mile reach of the Pithlachascotee River in Florida. These data include areal flood-frequency relations and flood heights for the 2-, 2.33-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals. Flood profiles are provided for the 2.33-, 5-, 10-, 100-, and 500-year recurrence intervals. Studies indicate that flood discharges in the study area are highly variable and are one-third to one-half of regional estimates. Differences between study area and regional estimates are due to large quantities of flood-water drainage to the regional aquifer system in the upper basin, a large karst area of about 138 square miles. Graded roads and bridges located at three sites along the upper study reach will be inundated by various frequency floods. Flood inundation maps can be prepared from flood data presented in this report. (Woodard-USGS) W80-00223

#### BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, TALLAHALIA CREEK AT WALDRUP, MISSISSIPPI

Geological Survey, Jackson, MS. Water Resources Div.; and Geological Survey, Montgomery, AL. Water Resources Div.; and Geological Survey, Baton Rouge, LA. Water Resources Div. For primary bibliographic entry see Field 6A. W80-00241

#### EFFECTS OF RAINFALL INTENSITY ON RUNOFF CURVE NUMBERS

Utah State Univ., Logan. Watershed Science Unit. R. H. Hawkins.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 53-64, 7 fig, 1 tab, 11 ref.

Descriptors: \*Rainfall-runoff relationships, \*Storm runoff, \*Runoff coefficient, \*Curves, \*Rainfall intensity, \*Infiltration, Forecasting, Hydrologic equation, Measurement, Design criteria.

The runoff curve number method developed by the SCS to calculate 'direct storm runoff', is analyzed here in terms of its appropriate usage, possible adjustments, augmentation or replacement. It is concluded that associating intensity and infiltration with curve numbers could lead to greater utilization of existing field measurements of infiltration. Accordingly, a rainfall partitioning approach is developed for application either as a guide in the selection of curve number in a design application with the choice depending upon the intensity distribution of the storm at hand compared to the CN distribution or where conditions merit, as an alternative to the curve number method. The two methods are compared while pointing out the assumption and limitations in application of both. (Tickes-Arizona) W80-00276

#### EPHEMERAL FLOW AND WATER QUALITY PROBLEMS: A CASE STUDY OF THE SAN PEDRO RIVER IN SOUTHEASTERN ARIZ.

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. S. J. Keith. In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona

Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 97-100, 1 tab, 5 ref.

Descriptors: \*Ephemeral streams, \*Water sources, \*Water quality, Non-perennial streams, Floods, Environmental effects, Basins, Planning, Comprehensive planning, Arizona, San Pedro River, Storm runoff, International waters, Water pollution sources.

Discontinuous water quality data for the San Pedro River in southeastern Arizona is analyzed to illustrate the nature of water quality problems of ephemeral flow. The San Pedro drains a northerly-trending basin of 4,483 square miles, of which 696 are in Mexico and 3,787 in Arizona. Several questions arise in the consideration of a rational management plan: what is the necessity for protection of ephemeral flow quality when the channel consists of a dry wash much of the year, where there is little aquatic or wildlife to protect, and where occasional flow during flood conditions is put to little use by humans; and where and how do we use the ephemeral flow it is indeed decided to utilize it. Such questions as these form the basis of this discussion in an effort to bring out the point that water quality problems of ephemeral flow in arid areas differ from those in the humid zone. It is argued that in between the extremes of prohibiting or treating all runoff or eliminating all sources of pollution, there is actually little that can be done to control all sources of pollution in this typical arid stream, despite the fact that standards, for the most part unattainable, have been set for this flow. (Tickes-Arizona) W80-00281

#### INTERFACIAL STABILITY IN CHANNEL FLOW

Vanderbilt Univ., Nashville, TN. Dept. of Environmental and Water Resources. R. H. French.

Journal of the Hydraulics Division, American Society of Civil Engineers, Vol. 105, No. HY8, Proceedings Paper 14768, p 955-967, August 1979, 4 fig, 2 tab, 17 ref, 2 append. OWRT A-044-TENN(2), 14-34-0001-7089, 14-34-0001-7090.

Descriptors: \*Open channel flow, \*Open channels, \*Density current, Mudflows, Density stratification, Interfaces, Turbulence, Hydraulics, Stability, \*Interfacial stability, Richardson number.

Interfacial stability in the special case of superposed turbulent layers with a zero velocity difference at the interface was examined. In contrast with previous investigations in which the primary mechanism of turbulence generation was interfacial shear, the primary source of turbulence was bottom boundary shear. Interfacial stability was defined in terms of two dimensionless parameters: the Keulegan number and a Richardson number based on the shear velocity and the maximum change in density across the flow. Laboratory flume data and field data taken downstream of thermal power plants on several rivers confirmed the hypothesis. (Lee-ISWS) W80-00297

#### WEED CONTROL METHODS FOR RIVER BASIN MANAGEMENT

Corps of Engineers, Washington, DC. For primary bibliographic entry see Field 2I. W80-00323

#### REAL-TIME CONVERSION OF RAINFALL TO RUNOFF FOR FLOW FORECASTING IN THE RIVER DEE

Institute of Hydrology, Wallingford (England). M. J. Lowing, R. K. Price, and R. A. Harvey. Paper 6, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 22 p, 9 fig, 3 tab, 14 ref.

Descriptors: \*Rainfall, \*Runoff, \*Forecasting, \*Mathematical models, Model studies, Rivers, Flow, Streamflow, Hydrographs, Radar, Rain gauges, Telemetry, Reservoirs, Reservoir operation, Watersheds(Basins), Hydrology, \*England, \*Wales, \*River Dee.

This paper described the model for converting recorded or estimated rainfall and forecast rainfall into flow hydrographs at various sites on the River Dee. The subcatchment routing and channel routing aspects were treated separately and the operational use of the combined model was discussed. It was suggested that, while the experience of producing and implementing a real-time forecasting system must be widely beneficial, the particular techniques used on the Dee may not be applicable elsewhere. (Sims-ISWS) W80-00334

#### CONTROL RULES FOR LONG AND SHORT TERM OBJECTIVES

Welsh National Water Development Authority, Chester (England).

A. O. Lambert, and R. J. Cameron.

Paper 7, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 23 p, 4 fig, 2 tab, 31 ref.

Descriptors: \*Flood control, \*Flow control, \*Reservoir operation, Rivers, Reservoirs, Lakes, Water levels, Streamflow, Storage, Runoff, Floods, Planning, Hydrographs, Hydrology, \*England, \*Wales, \*River Dee.

The paper had two purposes, to review general techniques for deriving control rules for river regulating reservoirs, and to describe control rules for the River Dee system. Control rules proposed as part of the Dee research program were compared with the current operational rules of the Welsh National Water Development Authority to illustrate examples of the difference in control rules derived from different points of view. (Sims-ISWS) W80-00335

#### FLOOD PROJECTS EXECUTED BY WMO ON FLOOD FORECASTING AND WARNING, USING RADAR AND/OR INTEGRATED TELEMETRY SYSTEMS

World Meteorological Organization, Geneva (Switzerland).

Paper 10, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 18 p, 5 fig.

Descriptors: \*Floods, \*Flood forecasting, \*On-site investigations, Radar, Telemetry, Rain gauges, Remote sensing, Projects, Rainfall, Precipitation(Atmospheric), Runoff, Forecasting, Meteorological data, Weather data, Meteorology, Hydrology.

In addition to the regular program activities in hydrology and water resources, the World Meteorological Organization (WMO) is also involved in technical cooperation field projects. The regular program activities are carried out within the Operational Hydrology Programme (OHP), mainly through the WMO Technical Commission for Hydrology, in close collaboration with the other WMO commissions. Hydrological forecasting is one of the substantive activities of the regular program and is included in the specific priority activities within the OHP for the period 1975 to 1980. The ongoing activities on hydrological forecasting include the preparation of guidance material on forecasting of ice formation and ice break-up, forecasting of low flows and related aspects of droughts, cost/benefit relationship of hydrological forecasts, influence of infiltration on forecasts of runoff, use of World Weather Watch systems for hydrological forecasting and forecasting of floods resulting from tropical cyclone rainfall. Most of the main field projects in hydrology are those on flood forecasting and warning, some have been successfully completed, and still many others are being executed. This paper described briefly 8 typical projects in this field. (Sims-ISWS) W80-00338

#### A TELEMETRY SYSTEM WORKING THROUGH THE PUBLIC TELEPHONE NETWORK

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

Louvain Univ. (Belgium).  
E. Persoons, G. Bazier, S. Musch, and J. C. Rouvet.  
Paper 11, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 10 p, 4 fig, 7 ref.

Descriptors: \*Flood control, \*Flood forecasting, \*Telemetry, \*Data transmission, Rivers, Rainfall, Precipitation (Atmospheric), Rain gages, Water levels, Flow, Flow control, Equipment, Instrumentation, Networks, Hydrology, Floods, Telephone networks.

These last years hydrologists are very interested in applying their studies to river flow forecasting. With the help of the mathematical theories of models and the increasing possibilities of fast treatment of the information, it is possible to construct hydrological models and to apply them in real time to forecast river flow. A direct utility of forecasting is flood regulation by, for example, diverting a part of the river flow into storm basins or by the maneuvering of weir gates. After a short description of the river studied, a system of measurement and treatment of the data was presented. The flexibility of use of the automatic telemetering system, controlled by mini-computer, helps in adopting programs of flow forecasting which will allow for an optimal command of the flow regulation devices. (Sims-ISWS)  
W80-00339

**REAL-TIME FLOOD FORECASTING FOR SOUTHERN CALIFORNIA**, University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.  
G. Fleming, and K. M. Leytham.  
Paper 12, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 12 p, 3 fig, 4 tab, 3 ref.

Descriptors: \*Flood forecasting, \*Flood control, \*Mathematical models, \*California, Rivers, Flow, Riverflow, Streamflow, Floods, Rainfall, Precipitation (Atmospheric), Forecasting, Computers, Computer programs, Model studies, Hydrology, \*Santa Ynez River (CA).

This paper examined the use of simulation techniques for real-time flow forecasting and considered the implications of using various forms of measured and forecast rainfall input. The Santa Ynez River in Southern California was considered as an example, and results were presented to demonstrate the benefits of using simulation techniques with both telemetered rainfall and quantitative precipitation forecasts as input. (Sims-ISWS)  
W80-00340

**RELATIVE ACCURACY OF CONNECTING CHANNEL DISCHARGE DATA WITH APPLICATION TO GREAT LAKES STUDIES**, National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
F. H. Quinn.  
Journal of Great Lakes Research, Vol. 5, No. 1, p 73-77, 1979. 2 fig, 2 tab, 6 ref.

Descriptors: \*Great Lakes, \*Discharge (Water), \*Flow, Measurement, Current meters, Data analysis, Channels, Rivers, River flow, Analytical techniques, Water balance, Lakes, Limnology, Hydrology, Connecting channels, Flow measurement.

The flows in the Great Lakes connecting channels are a major component in the water balance of the Great Lakes Basin. The increased emphasis on Great Lakes water quality and quantity requires an assessment of the accuracy of both measured and computed connecting channel discharge data. In this study, the standard error of typical discharge measurements was found to be approximately 3 to 5%, depending upon the number of panels used in the cross section. Measurement sets were found to have a practical limit of about 25 measurements. The standard error of a set of measurements was found to be on the order of 1%. The procedure

used to compute the published flows of the Niagara River was found to have an apparent bias of about 2% on the high side. It was recommended that the published Niagara River flows be adjusted prior to use in detailed water balance studies. (Sims-ISWS)  
W80-00347

### 2F. Groundwater

**STOCHASTIC ANALYSIS OF STEADY STATE GROUNDWATER FLOW IN A BOUNDED DOMAIN 1. ONE-DIMENSIONAL SIMULATIONS**, British Columbia Univ., Vancouver. Dept. of Geological Sciences.  
L. Smith, and R. A. Freeze.  
Water Resources Research, Vol. 15, No. 3, p 521-528, June 1979. 10 fig, 13 ref.

Descriptors: \*Monte Carlo method, \*Groundwater movement, \*Steady flow, \*Model studies, Stochastic processes, Statistical models, Hydraulic conductivity, Homogeneity, Correlation analysis, Boundaries (Surfaces), Artesian heads, Water levels, Nearest-neighbor stochastic process model, Hydraulic head, Standard deviation, One-dimensional model.

A stochastic analysis of one-dimensional, steady-state groundwater flow through a bounded domain was carried out by using Monte Carlo simulation techniques. The flow domain was divided into a finite set of discrete blocks. Hydraulic conductivity values in neighboring blocks were autocorrelated by assuming that the spatial variations in conductivity can be represented by a first-order, nearest neighbor, stochastic process model. An integral scale was defined to characterize the average distance over which conductivity values in the block system are autocorrelated. This model leads to a realistic representation of the spatial variations in hydraulic conductivity in a discrete block medium. Results of the simulations provided estimates of the output distributions in hydraulic head. It was shown that the ratio of the integral scale for conductivity to the distance between boundary points is a fundamental parameter in modeling the stochastic behavior of a bounded statistically homogeneous medium. The standard deviation in hydraulic head increases with an increase in either the standard deviation in hydraulic conductivity or the strength of the correlation between neighboring conductivity values. The standard deviation in head does not significantly depend upon the block size or the total number of blocks included along the flow line, provided a sufficiently accurate representation of the autocorrelation function is made. (Visocky-ISWS)  
W80-00070

**A DIRECT SOLUTION TO THE INVERSE PROBLEM IN GROUNDWATER FLOW**, Princeton Univ., NJ. Dept. of Civil Engineering.  
D. H. Tang, and G. F. Pinder.  
Advances in Water Resources, Vol. 2, No. 2, p 97-99, June 1979. 5 fig, 3 ref. NSF ENG76-18957.

Descriptors: \*Transmissivity, \*Groundwater movement, \*Analytical techniques, \*Model studies, Mathematical models, Groundwater, Aquifers, Pumping, Recharge, Natural recharge, Hydrologic properties, Aquifer characteristics, Finite difference analysis.

The inverse problem for transmissivity was solved deterministically using a finite difference approach. Steady state hydraulic heads calculated from a preliminary experiment were used as input data. It was shown that if the data on the hydraulic head are known at a sufficiently large number of points, there is no difficulty in setting up a finite difference grid and solving for transmissivity with an acceptable error. (Sims-ISWS)  
W80-00081

**BOUNDARY ELEMENT METHOD FOR FLUID FLOW**, Southampton Univ. (England). Dept. of Civil En-

gineering.  
For primary bibliographic entry see Field 8B.  
W80-00083

**SYSTEMATIC SAMPLING OF GAUSSIAN RANDOM PROCESSES AND FIELDS**, Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.  
D. Veneziano, and C. S. Queiroz.  
Water Resources Research, Vol. 15, No. 3, p 703-713, June 1979. 9 fig, 1 tab, 12 ref. NSF ENG75-19400.

Descriptors: \*Sampling, \*Network design, \*Theoretical analysis, Probability, Stochastic processes, Groundwater, Water levels, Rainfall, Rain gages, Networks, Analytical techniques, Random processes, Bayesian analysis, Kolmogorov-Wiener's filter.

Linear observation of Gaussian random functions always results in reduction of uncertainty, and since the posterior central moments are precomputable, optimal linear sampling schemes for variance reduction are nonsequential. In particular, systematic sampling of homogeneous Gaussian processes and fields, the latter on rectangular grids, leads to simple variance-updating equations. Cases when measurements are noisy, when linear transformations of the uncertain function are observed or estimated, and when nonparametric uncertainty is superposed to a random parametric trend lead to simple variants of the direct observation/estimation model. The basic analytical tool is the Kolmogorov-Wiener filter, either in the frequency or in the space domain. Application areas include the design of rainfall collection networks, inference of soil properties for geotechnical use, mineral exploration, biological and environmental sampling, materials testing, and quality control. (Sims-ISWS)  
W80-00089

**SOLUTION OF LINEARIZED BOUSSINESQ EQUATION WITH STOCHASTIC BOUNDARIES AND RECHARGE**, Punjab Agricultural Univ., Ludhiana (India). Dept. of Civil Engineering.  
B. Sagar.  
Water Resources Research, Vol. 15, No. 3, p 618-624, June 1979. 3 fig, 25 ref.

Descriptors: \*Groundwater, \*Groundwater movement, Recharge, \*Model studies, Mathematical models, Natural recharge, Flow, Rivers, Statistics, Equations, Mathematics, Stochastic processes, Analytical techniques, Boussinesq equation.

By using the method of eigenfunction expansion, a solution to the linearized Boussinesq equation with stochastic initial conditions, boundaries, and recharge was obtained. The solution was obtained explicitly in the form of two expressions, one for the expected value of the dependent variable and the other for its covariance. The inclusion of both the Neumann and the Dirichlet boundary conditions was considered. It was found that the expected value of the dependent variable is the same as the solution of the deterministic problem with expected values of the input stochastic quantities. An example of the use of the solution was presented. From the result of the example it was seen that the initial condition contributes a major portion to the standard deviation of the dependent variable. (Sims-ISWS)  
W80-00093

**THE SIGNIFICANCE OF THE STORAGE PARAMETER IN SATURATED-UNSATURATED GROUNDWATER FLOW**, California Univ., Berkeley. Lawrence Berkeley Lab.  
T. N. Narasimhan.  
Water Resources Research, Vol. 15, No. 3, p 569-576, June 1979. 14 fig, 1 tab, 18 ref. Dep. Energy W-7405-ENG-48.

Descriptors: \*Storage coefficient, \*Aquifers, \*Unsaturated flow, \*Saturated flow, Groundwater movement, Consolidation, Effective stress, Porosity, Deformation, Porous media, Aquifer charac-

## Groundwater—Group 2F

teristics, Theoretical analysis, Saturation, Void volume.

An essential feature of transient groundwater movement is the phenomenon of change in groundwater storage. Storage change is governed by three fundamental processes, change in void volume of the skeleton, change in fluid saturation, and change in fluid density. Since the expansivity of water is very small, the phenomenon of change in storage in fully saturated media is dominated by matrix deformation. When the soil is partially saturated, it is customarily assumed that the matrix is essentially rigid and that desaturation is the only process governing change in storage. While these assumptions may be reasonable at relatively low saturations, they may not be valid at high saturations or in the transition zone between the saturated and unsaturated regimes. The key to understanding of this lies in a proper appreciation of the constitutive relationships that exist between mechanical stresses on the one hand and moisture suction on the other. This paper examined the theoretical as well as the practical consequences of the role of soil deformation in saturated-unsaturated groundwater flow. (Visocky-ISWS) W80-00094

**DIFFUSION OF DISSOLVED GAS IN CONSOLIDATING POROUS MEDIA,** Middle East Technical Univ., Ankara (Turkey). Dept. of Geological Engineering. M. Y. Corapcioglu. Water Resources Research, Vol. 15, No. 3, p 563-568, June 1979. 7 fig, 21 ref.

Descriptors: \*Diffusion, \*Soil gases, \*Porous media, \*Soil compaction, Mathematical models, Permeability, Equations, Air entrainment, Groundwater movement, Consolidation, Pore pressure, Gases, Groundwater, Velocity, Seepage, Hydraulic properties, Model studies.

The diffusion of dissolved gas in liquid resulting from soil consolidation was analyzed as a function of time and space. The medium was assumed to be isotropic, finite, and filled with a homogeneous and incompressible fluid. Two cases of consolidation were considered to determine the fluid velocity expression. The model is useful to predict the concentration of dissolved gas in liquid for laboratory problems. (Visocky-ISWS) W80-00095

**TRICHLOROFLUOROMETHANE IN GROUNDWATER—A POSSIBLE TRACER AND INDICATOR OF GROUNDWATER AGE,** Indiana Univ. at Bloomington. Dept. of Geology. G. M. Thompson, and J. M. Hayes. Water Resources Research, Vol. 15, No. 3, p 546-554, June 1979. 5 fig, 3 tab, 33 ref.

Descriptors: \*New Jersey, \*Arkansas, \*Texas, \*Groundwater, \*Tracers, \*Dating, Age, Atmospheric fallout, Aerosols, Tritium, Gas chromatography, Analytical techniques, Groundwater recharge, Springs, Wells, Samples, \*Trichlorofluoromethane, \*Freon-11, Concentration.

Trichlorofluoromethane, an entirely man-made material, has become a detectable component of the atmosphere. Because of its unique atmospheric history, the presence of CCl<sub>3</sub>F in groundwater is potentially significant in terms of groundwater age. The age relationship stems from the fact that precipitation, exposed to CCl<sub>3</sub>F in the atmosphere, will pick up an amount that is proportional to the atmospheric CCl<sub>3</sub>F concentration. If a portion of this water infiltrates into the subsurface to become groundwater, it can be differentiated from older groundwater (that infiltrated prior to the buildup of CCl<sub>3</sub>F in the atmosphere) on the basis of its CCl<sub>3</sub>F content. In order to evaluate the temporal significance of CCl<sub>3</sub>F in groundwater, preliminary investigations were conducted in 3 areas where the hydrology was well understood and where tritium measurements had been made in the past. They were: the Wharton tract of southern New Jersey; Hot Springs National Park in Hot Springs, Arkansas; and the Edwards aquifer of south central

Texas. Good agreement was observed between the CCl<sub>3</sub>F data and the hydrologic controls. The Texas study also revealed a series of anomalous CCl<sub>3</sub>F concentrations (up to 35 X 10 to the -9th power g CCl<sub>3</sub>F/l H<sub>2</sub>O) that were too high to be of atmospheric origin. The anomalous points occurred in a line extending from the northwest corner of San Antonio for a distance of 74 km northeast along the Balcones fault zone and were interpreted as representing the migration of CCl<sub>3</sub>F from a point source, thus indicating the potential of this and similar compounds as hydrologic tracers. (Visocky-ISWS) W80-00096

**A COMPARISON OF FLUORESCIN DYE AND ANTIBIOTIC-RESISTANT ESCHERICHIA COLI AS INDICATORS OF POLLUTION IN GROUNDWATER,** Oregon State Univ., Corvallis. Dept. of Microbiology. For primary bibliographic entry see Field 2G. W80-00145

**GROUND-WATER DATA IN THE BAKER COUNTY-NORTHERN MALHEUR COUNTY AREA, OREGON,** Geological Survey, Portland, OR. Water Resources Div. C. A. Collins. Geological Survey open-file report 79-695, 1979. 28 p, 3 fig, 1 plate, 4 tab, 19 ref.

Descriptors: \*Groundwater resources, \*Water wells, \*Springs, \*Water yield, \*Water quality, Well data, Drillers logs, Water level fluctuations, Water analysis, Chemical analysis, Aquifers, Oregon, \*Baker County.

Ground-water data for the Baker County-northern Malheur area, Oregon, are tabulated for the Bureau of Land Management. The data include well and spring records, a well-location map, drillers' logs of wells, observation-well hydrographs, and chemical analyses of ground-water samples. The reported yields of wells and springs in the area ranged from less than 1 to 2,500 gallons per minute. Dissolved solids in ground-water samples ranged from 50 to 1,587 milligrams per liter, and arsenic ranged from 0.001 to 0.317 milligrams per liter. (Woodard-USGS) W80-00226

**GROUND-WATER RESOURCES OF WASHINGTON PARISH, LOUISIANA,** Geological Survey, Baton Rouge, LA. Water Resources Div. H. L. Case, III. Louisiana Department of Public Works Water Resources Technical Report No. 18, 1979. 33 p, 7 fig, 7 plates, 3 tab, 18 ref.

Descriptors: \*Groundwater resources, \*Aquifer characteristics, \*Water quality, \*Water wells, \*Water utilization, Water levels, Hydrographs, Hydrogeology, Groundwater availability, Water yield, \*Washington Parish(LA).

More than 31 million gallons per day of water is pumped from freshwater aquifers in Washington Parish, LA. The aggregate thickness of freshwater sands ranges from 850 to 1,910 feet, and altitude of the base of freshwater ranges from 1,870 to 3,320 feet below National Geodetic Vertical Datum of 1929 (NGVD). The shallow aquifer in Washington Parish ranges in thickness from less than 50 feet to more than 400 feet. In local areas, wells completed in the shallow aquifer are capable of yielding as much as 2,900 gallons per minute. Water levels in wells in the shallow aquifer range from more than 10 feet above to more than 130 feet below land surface. Water from the shallow aquifer is generally low in dissolved solids, iron, and manganese concentrations; pH is generally less than 6.0 units. Eight major freshwater aquifers ranging in thickness from 50 to more than 360 feet and well depths ranging from less than 50 to more than 2,200 feet below land surface are available in the Bogalusa area. Four major aquifers have been identified in the Franklinton area. Thicknesses range from 100

feet in the Kentwood aquifer to 250 feet in the Franklinton aquifer. Well depths range from 585 feet (Kentwood aquifer) to 2,746 feet (Franklinton aquifer) below land surface. Water from the Kentwood and Franklinton aquifers contains low concentrations of dissolved iron and manganese. (Woodard-USGS) W80-00227

**DEVELOPING A STATE WATER PLAN, GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1979,** Geological Survey, Salt Lake City, UT. Water Resources Div. D. Price. Utah Division of Water Resources Cooperative Investigations Report No. 18, 1979. 68 p, 37 fig, 3 tab, 3 ref.

Descriptors: \*Groundwater resources, \*Utah, \*Aquifers, \*Withdrawal, \*Water level fluctuations, Water quality, Water wells, Water utilization, Water supply, Irrigations, Hydrogeology, Aquifers, Water table, Potentiometric level, Groundwater recharge, Hydrologic data, Precipitation(Atmospheric), Surface-groundwater relationships, Hydrographs, Mapping.

The estimated total withdrawal of water from wells in Utah in 1978 was about 829,000 acre-feet, which was about 118,000 acre-feet less than in 1977 and 62,000 acre-feet greater than the average annual withdrawal for the period 1968-77. The decrease from 1977 was due primarily to decreases in withdrawals for irrigation. Precipitation in 1978 was above average in most of Utah. This made more surface water available, reducing dependence on ground water for irrigation. Relatively small ground-water declines were recorded in some of the more heavily developed areas. The above-average precipitation combined with increased runoff and reduced ground-water withdrawals, however, resulted in significant rises of ground-water levels in many parts of the State. (Woodard-USGS) W80-00230

**APPLICATION OF GEOCHEMICAL KINETIC DATA TO GROUND-WATER SYSTEMS: A TUFFACEOUS-ROCK SYSTEM IN SOUTHERN NEVADA,** Geological Survey, Denver, CO. Water Resources Div. For primary bibliographic entry see Field 2K. W80-00232

**TWO-DIMENSIONAL AND THREE-DIMENSIONAL DIGITAL FLOW MODELS FOR THE SALINAS VALLEY GROUND-WATER BASIN, CALIFORNIA,** Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 2A. W80-00238

**MAPS SHOWING GROUND-WATER CONDITIONS IN THE LOWER SANTA CRUZ AREA, FINAL, PIMA, AND MARICOPA COUNTIES, ARIZONA—1977,** Geological Survey, Tucson, AZ. Water Resources Div. For primary bibliographic entry see Field 7C. W80-00239

**USE OF DIGITAL MODELS TO MANAGE GROUNDWATER,** Fox (F.M.) and Associates, Inc., Spokane, WA. G. E. Maddox. In: Watershed Management. Proceedings of a Symposium conducted by the Irrigation and Drainage Division of the American Society of Civil Engineers, Logan, Utah, August 1975. p 568-579, 1975. 6 fig, 2 ref. ASCE, New York, N.Y.

Descriptors: \*Groundwater, \*Management, \*Model studies, \*Water policy, \*River basins, Projects, Hydrology, Water storage, Water level, Irrigation water, Columbia River(WA), \*Quincy

## Field 2—WATER CYCLE

### Group 2F—Groundwater

basin(WA), Reservoirs, Systems analysis, Recharge, Percolation.

Reported is an investigation made of the Quincy basin, the northernmost of three groundwater basins within the Columbia Basin Project. The study determined, in quantitative terms, the amount of natural recharge in the basin and how much groundwater was stored there as a result of deep percolation of irrigation water imported by the Project. Discussed are two digital models used in the analysis of hydrologic data and the water management policy stemming from the first model. (Bell-Graf-Cornell)  
W80-00252

**BIOGEOCHEMISTRY OF A FORESTED ECOSYSTEM.**  
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.  
For primary bibliographic entry see Field 4C.  
W80-00328

**EXACT AQUITARD RESPONSE FUNCTIONS FOR MULTIPLE AQUIFER MECHANICS.**  
Waterloo Univ. (Ontario). Dept. of Earth Sciences. E. O. Frind.  
Advances in Water Resources, Vol. 2, No. 2, p 77-82, June 1979. 6 fig, 1 tab, 16 ref.

Descriptors: \*Aquitards, \*Aquifers, \*Pumping, Water levels, Hydraulic conductivity, Groundwater, Theoretical analysis, Mathematical models, Equations, Analytical techniques, Aquitard response.

The aquitard response functions in multiple aquifer mechanics were examined in some detail, and a general family of response functions was derived. Taking advantage of the known fact that the nature of the aquitard response passes through different stages in time, three distinct response periods were identified, and time limits for each period were precisely defined. It was found that the response functions that are presently known as approximations are, for all practical purposes, exact if stated with the appropriate time constraints. (Sims-ISWS)  
W80-00356

**FRESHWATER AND THE FLORIDA COAST: SOUTHWEST FLORIDA.**  
For primary bibliographic entry see Field 6E.  
W80-00367

**IDENTIFICATION OF AQUIFER DISPERSIVITIES IN TWO-DIMENSIONAL TRANSIENT GROUNDWATER CONTAMINANT TRANSPORT: AN OPTIMIZATION APPROACH.**  
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.  
A. Umari, R. Willis, and P. L. F. Liu.  
Water Resources Research, Vol. 15, No. 4, p 815-831, August 1979. 2 fig, 10 tab, 26 ref, 1 append.

Descriptors: \*Aquifers, \*Dispersion, \*Groundwater, \*Optimization, \*Methodology, \*Contaminant transport, Nonlinear programming, Minimization, Quasilinearization, Inverse algorithm, Linear programs, Finite differencing, Discretize, Iterative procedure, Sensitivity, Finite element analysis, Constraints, Effects, Equations, Mathematical models, Systems analysis.

The problem of identifying unknown aquifer dispersivities in two-dimensional transient groundwater contaminant transport from given observations on the concentration field is addressed. This inverse problem is formulated as a general nonlinear programming problem, the purpose of which is to minimize the discrepancy between calculated and observed values of the concentration field. The method of quasilinearization is used to linearize the above problem, and the inverse algorithm becomes the solution of a sequence of linear programs that converge to the solution of the original nonlinear problem. The finite elements method in conjunction with finite differencing is used to discretize the governing differential equations which

are then used as constraints for the optimization (mathematical programming) problem stated above. The effect on the inverse problem of the choice of observation points, objective function, number of finite elements, size of time step, and observation errors is studied. The proposed identification algorithm is shown to be fast, stable, and accurate. (Bell-Graf-Cornell)  
W80-00393

## 2G. Water In Soils

**THE COMPRESSIBILITY AND HYDRAULIC DIFFUSIVITY OF A WATER-STEAM FLOW.**  
Department of Scientific and Industrial Research, Wellington (New Zealand).  
M. A. Grant, and M. L. Sorey.  
Water Resources Research, Vol. 15, No. 3, p 684-686, June 1979. 5 ref, 1 append.

Descriptors: \*Compressibility, \*Diffusivity, \*Porous media, \*Flow, Theoretical analysis, Model studies, Mathematical models, Pressure, Temperature, Heat flow, Soil water, Soil water movement, Permeability, Soil science, Agriculture, Hydraulic diffusivity.

Physical parameters were defined for a flow of water and steam in a porous medium: dynamic and kinematic viscosity, density, and compressibility. These parameters permitted single-phase pressure transient theory to be applied to two-phase flow provided that the pressure changes are not too large. (Sims-ISWS)  
W80-00090

**FIELD TEST OF SOLUTION FLOW MODELS IN A HETEROGENEOUS IRRIGATED CROPPED SOIL.**  
Agricultural Research Organization, Bet Dagan (Israel). Inst. of Soils and Water.  
E. Bresler, H. Bielorai, and A. Laufer.  
Water Resources Research, Vol. 15, No. 3, p 645-652, June 1979. 8 fig, 1 tab, 19 ref.

Descriptors: \*Irrigation, \*Model studies, \*On-site investigations, Mathematical models, Soils, Soil water, Soil water movement, Moisture content, Hydraulic conductivity, Salts, Solutes, Salinity, Sprinkler irrigation, Crops, Agriculture, \*Israel.

Data obtained from a controlled irrigation experiment in a citrus grove were compared with results obtained from simultaneous water and salt flow models considering water uptake by the trees. In the models, spatial variability in soil hydraulic properties was taken into account by using a single dimensionless scaling parameter which allowed the range of the soil water retentivity  $h(\theta)$  and hydraulic conductivity  $K(\theta)$  functions to be approximated with a probability of about 0.95. Measured data of water content profiles were obtained with the aid of the neutron probe method. Saturated paste extracts of disturbed soil samples were used for the measured salt profile data. Variability in the water and salt content observations was expressed in terms of the 95% confidence limits (CL) of the measurements made in 6 replications at each of the 3 experimental treatments. An irrigation period of 7 months was simulated and compared each year. The comparisons between models and experiments were based on average values, on ranges of CL of field data, and on simulated results computed with highly probable ranges of soil hydraulic properties. The results suggested that for estimating field values of water content ( $\theta$ ) and salt distribution profiles with approximate ranges of  $K(\theta)$  and  $h(\theta)$  at a given probability, the models have been sufficiently developed. (Sims-ISWS)  
W80-00091

**THE SIGNIFICANCE OF THE STORAGE PARAMETER IN SATURATED-UNSATURATED GROUNDWATER FLOW.**  
California Univ., Berkeley. Lawrence Berkeley Lab.  
For primary bibliographic entry see Field 2F.  
W80-00094

**DIFFUSION OF DISSOLVED GAS IN CONSOLIDATING POROUS MEDIA.**  
Middle East Technical Univ., Ankara (Turkey).  
Dept. of Geological Engineering.  
For primary bibliographic entry see Field 2F.  
W80-00095

**METHOD AND DEVICE FOR DETERMINING THE PORE WATER PRESSURE IN A SOIL.**  
B. A. Torstenson.  
U.S. Patent No. 4,148,212, 5 p, 3 fig, 5 ref; Official Gazette of the United States Patent Office, Vol. 981, No. 2, p 436, April 10, 1979.

Descriptors: \*Patents, \*Measurement, \*Pore water, \*Pore pressure, Soil pressure, Soil physical properties, Equipment.

A method for determining the pore water pressure in a soil is described. A water-filled tube bearing a pore pressure sound at its lower end is installed at the required level. The pore pressure sound bears a filter through which the pore pressure in the soil is conveyed. A measuring device is lowered down the tube and fitted on to the pore pressure sound. The pore pressure is then allowed to stabilize after which a reading is taken which represents the pore pressure in the soil. The measuring device is disconnected from the pore pressure sound and a reading is taken which represents the water pressure in the tube. The pore pressure is calculated by comparison of the reading for pore water pressure and the water pressure in the tube, using a calibration factor for the measuring device. (Sinha-OEIS)  
W80-00110

**A COMPARISON OF FLUORESCIN DYE AND ANTIBIOTIC-RESISTANT ESCHERICHIA COLI AS INDICATORS OF POLLUTION IN GROUNDWATER.**  
Oregon State Univ., Corvallis. Dept. of Microbiology.  
T. M. Rahe, C. Hagedorn, and E. L. McCoy.  
Water, Air, and Soil Pollution, Vol. 11, No. 1, p 93-103, January 1979. 1 fig, 2 tab, 12 ref. OWRT A-039-ORE(1).

Descriptors: \*Soil water movement, \*Tracers, \*Oregon, On-site tests, Groundwater, Groundwater movement, Measurement, Testing procedures, Methodology, Tracking techniques, Subsurface waters, Fluorescent dye, E coli, Flow, Water pollution, Pollutants.

Field experiments were conducted to evaluate the performance of antibiotic-resistance *Escherichia coli* and yellow fluorescein dye as tracers of subsurface water flow. These materials were released into three horizontal lines installed in the A, B, and C horizons of a western Oregon hillslope soil. Movement was evaluated by collecting groundwater samples from rows of modified piezometers (6 piezometers/row) placed at various depths and distances downslope from the injection lines. The *E. coli* cells were transported rapidly through the experimental site and were recovered from piezometers 15 m downslope only 1 h after inoculation, while the rate by which the bacteria were moved was at least 1500 cm/h in the B-horizon. The strains of *E. coli* survived in large numbers for the duration of the 12 h sampling periods and appeared to be satisfactory as tracers of subsurface water flow. In contrast, the fluorescein dye was never visually detectable in any of the piezometers during any of the sampling periods, although very small, residual amounts could be fluorimetrically measured. These results indicated that consideration should be given to more frequent use of marked strains of bacteria as tracers since these organisms may represent, in the final analysis, a very suitable option for closely monitoring subsurface movement and the spread of pollutants in soil and groundwater. (Humphreys-ISWS)  
W80-00145

**THERMAL CONDUCTIVITY OF SOILS AS A FUNCTION OF TEMPERATURE AND WATER CONTENT.**  
Oregon State Univ., Corvallis. Agricultural Experiment Station.

## Lakes—Group 2H

A. R. Sepaskhah, and L. Boersma.  
Soil Science Society of America Journal, Vol. 43,  
No. 3, p 439-444, May-June 1979. 5 fig, 2 tab, 22  
ref. OWRT B-028-ORE(7).

Descriptors: \*Thermal conductivity, \*Soil moisture, \*Moisture content, \*Temperature, \*Soil, Heat flow, Model studies, Measurement, Porosity, Diffusion, Air entrainment, Water vapor, Surface tension, Thermal properties, Mass enhancement factor, Pore size distribution.

Apparent thermal conductivities of loamy sand, loam, and silty clay loam soils were measured with a cylindrical heat probe at several water contents and temperatures. Values of lambda were also calculated with the de Vries model. Results showed that the model may be used satisfactorily to calculate lambda. The contribution of vapor distillation to thermal conductivity was analyzed by comparing lambda at 25 and 45 °C. The ratios lambda sub 45/lambda sub 25 were nearly equal to unity when less than 5% of total pore space was filled with water. The ratios increased, due to vapor distillation, as water filled the pores and reached maximum values of 2.17, 2.71, and 2.96 when 22, 27, and 35% of total pore space was filled with water corresponding to soil water potentials of -0.8, -9.0, and -8.0 bars for loamy sand, loam, and silty clay loam, respectively. As the water content increased further, the ratios decreased and approached unity when more than 50% of total space was filled with water. The apparent thermal conductivity was independent of water content at very low water contents. The water molecules are in layers only a few molecules thick. The water content below which the apparent thermal conductivity is not affected by water content is a function of the soil temperature and the clay content. In the reported experiments, these water contents were 0.03 and 0.05 cm<sup>3</sup>/cm<sup>3</sup> at 45 °C and 0.13 and 0.18 cm<sup>3</sup>/cm<sup>3</sup> at 25 °C for the loam and silty clay loam, respectively. (Visocky-ISWS)  
W80-00146

**SIMPLE TIME-POWER FUNCTIONS FOR RAINWATER INFILTRATION AND RUNOFF**, Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.  
R. M. Dixon, J. R. Simanton, and L. J. Lane.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az., p 79-89, 7 tab, 5 fig, 19 ref.

Descriptors: \*Infiltration, \*Rainfall-runoff relationships, \*Runoff, \*Runoff forecasting, \*Soil water movement, Infiltrometers, Irrigation practices, Rain water, Rainfall disposition, Air-earth interfaces, Equations, Forecasting, Regression analysis, Erosion.

The main purpose of the study was to evaluate several simple infiltration equations for use in quantifying the air-earth interface (AEI) descriptive concept developed by Dixon (1977) for controlling rainwater infiltration. Eight equations, Darcy's Kostikov's, Ostashev's and four modified Philip equations were least square fitted to data from ring, border-irrigation, closed-top, and sprinkling infiltrimeters and evaluated for use in predicting and controlling rainwater infiltration and rainwater excess in crop and rangelands. The 16 evaluation criteria elucidated here were developed to facilitate the initial screening of the many infiltration equations to select several for subsequent fitting accuracy tests and to guide final selection of the best equation for modeling the AEI concept. The 8 equations which were also fitted to rainfall data to permit the calculation of runoff from a small surface area, were compared by resultant regression curves to indicate that land management practices that suitably alter the soil surface will permit the control of infiltration runoff and erosion. Kostikov's equation was selected for modeling the AEI concept of infiltration because of its ability to accurately and consistently fit data from diverse sources and its meaningful parameters which provide a convenient method for summarizing

infiltration data and predicting and controlling infiltration and runoff. (Tickes-Arizona)  
W80-00279

**A MICROROUGHNESS METER FOR EVALUATING RAINWATER INFILTRATION**, Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.

J. R. Simanton, R. M. Dixon, and I. McGowan.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 171-174, 2 fig, 8 ref.

Descriptors: \*Measurement, \*Soil surfaces, \*Soil water movement, \*Infiltration, \*Instrumentation, Earth-water interfaces, Ranges, Infiltrimeters, Moisture meters, Microenvironments, Arizona.

Described is a microroughness meter developed to obtain numerous and accurate measurements of rangeland surface microroughness and characteristics. The meter, which consists of four basic parts: (1) meter base and pin guide, (2) pin lifting support bar and lifting mechanism, (3) 100 vertically moving pins, and (4) stripchart support guide and winding mechanism, was designed to measure soil surface evaluations and characteristics of a 1m<sup>2</sup> plot. Performance tests on multi-plot sprinkler-infiltrimeter studies conducted on the Santa Rita Experimental Range in southeastern Arizona indicated that the meter was accurate and relatively precise in repeating soil surface roughness measurements but was not precise in defining the theoretical characteristics of constructed surfaces. It was concluded, however, that these errors in precision were insignificant and due partly to surface geometry construction errors and that the meter is a convenient, quick, simple and accurate means of measuring surface roughness in studies requiring many plots and data points. (Tickes-Arizona)  
W80-00291

**SUBSTRATE CONDITIONS, COMMUNITY STRUCTURE AND SUCCESSION IN A PORTION OF THE FLOODPLAIN OF WISSAHICKON CREEK**, For primary bibliographic entry see Field 2B.  
W80-00310

**PYRITE: ITS RAPID FORMATION IN A SALT MARSH AND ITS IMPORTANCE TO ECOSYSTEM METABOLISM**, Woods Hole Oceanographic Institution, MA. Joint Program in Biological Oceanography.  
For primary bibliographic entry see Field 2K.  
W80-00311

**MARSH SOILS OF THE ATLANTIC COAST**, Delaware Univ., Newark. Dept. of Plant Science.  
L. J. Cohn.  
In: Ecology of Halophytes, Reimold, R. J., and Queen W. H. (eds.), Academic Press, Inc., New York, p 441-447, 1974. 21 ref.

Descriptors: \*Marshes, \*Soil classifications, Wetlands, Salt marshes, Peat, Soil tests, Remote sensing, Atlantic coastal plain.

Recent attempts to classify marsh soils are reviewed and the difficulties involved in studying and mapping marsh soils are discussed. (Steiner-Mass)  
W80-00320

**PRIMARY PRODUCTIVITY OF ALPINE MEADOW COMMUNITIES**, F. E. Wielgolaski.  
In: Fennoscandian Tundra Ecosystems: Plants and Microorganisms, edited by F. E. Wielgolaski, Springer-Verlag, N.Y., Heidelberg, Berlin, p 121-128, 1975. 1 fig, 4 tab, 25 ref.

Descriptors: \*Primary productivity, \*Alpine, \*Grasslands, \*Biomass, \*Standing crop, Willow

trees, Shrubs, Grasses, Roots, Ferns, Mosses, Algae, Fungi.

Comparing plant production in a dry and wet alpine meadow indicated wet meadows had greater plant production than dry, with a large part of that production occurring in roots. Fertilizer studies indicated a weak tendency to increase yield with the largest amount of mixed fertilizer. The living root biomass is higher than aboveground live biomass. The shoot-root ratio is lowest for Carex species. Most roots were in the upper 10 cm soil layer; in the wet meadow, more than 60%—in the dry, somewhat less. Only 15-20% of the roots are living below a 10 cm depth in the wet meadow. There are more live roots compared to dead in the dry meadow than in the wet. About 4-5% of the total material of bryophytes is dead in the upper 5-6 cm in the wet meadow. Green vascular plant material in the dry meadow may increase by 85 gm to the minus 2nd power, and in the wet by 80 gm to the minus 2nd power. The primary production of roots is higher in the wet than in the dry meadow. The production of cryptogams is 3 to 4 times higher in the wet than dry meadow. (Ottello-Mass)  
W80-00324

## 2H. Lakes

**USE OF COMPLEX PALEOGEOGRAPHIC METHOD TO RECOGNIZE THE HISTORY OF DISTROPHIC LAKES AND HIGH BOGS AS EXEMPLIFIED BY AN INTERGLACIAL LAKE AT GOLKOW NEAR WARSZAWA**, S. Z. Rozyczki.  
Polskie Archiwum Hydrobiologii, Vol. 25, No. 1/2, p 361-367, 1978. 5 fig, 7 ref.

Descriptors: \*Lakes, \*Paleoclimatology, \*History, Bogs, Palynology, Geomorphology, Glaciation, Stratigraphy, Hydrogeology, Geologic mapping.

A complex paleogeographic and stratigraphic analysis has been done taking as an example a dystrophic interglacial lake. It was based on various geomorphological hydrologic, sedimentological, and palynological data. The subsequent changes in the extents of the lake waters and changes of the landscape in the vicinity during the main climatic oscillations from the decline of the Middle-Polish glaciation till recent times are shown. It has been found that the lake basin was filled with water during the three warmest phases of the Eemian interglacial. The lake has disappeared after the second interglacial optimum. The subsequent history of the lake basin embraces next phases of its erosional dissection and infilling with sediments during the last great cold phase of the Wurm. (Steiner-Mass)  
W80-00007

**SEASONAL CHANGES OF PHRAGMITES COMMUNIS TRIN. PART I. GROWTH, MORPHOMETRICS, DENSITY AND BIOMASS**, Polish Academy of Sciences, Warsaw. Dept. of Biocenology.  
For primary bibliographic entry see Field 2I.  
W80-00011

**ROLE OF CARBOHYDRATE IN HALOPHYTES OF THE REGION OF NEUSIEDLER LAKE, AUSTRIA, (IN GERMAN)**, Vienna Univ. (Austria). Pflanzenphysiologisches Inst.  
For primary bibliographic entry see Field 2I.  
W80-00021

**PRIMARY PRODUCTIVITY OF EMERGENT MACROPHYTES IN A WISCONSIN MARSH ECOSYSTEM**, Wisconsin Univ.-Milwaukee. Dept. of Botany.  
For primary bibliographic entry see Field 2I.  
W80-00026

**DEPRESSION OF PH IN LAKES AND STREAMS IN CENTRAL ONTARIO DURING SNOWMELT**,

## Field 2—WATER CYCLE

### Group 2H—Lakes

Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.  
D. S. Jeffries, C. M. Cox, and P. J. Dillon.  
Journal of the Fisheries Research Board of Canada, Vol. 36, No. 6, p 640-646, June 1979. 1 fig, 4 tab, 28 ref.

Descriptors: \*Snowmelt, \*Water quality, \*Canada, \*Lakes, \*Hydrogen ion concentration, Streams, Surveys, Surface runoff, Spring, On-site data collections, Watersheds(Basins), Sampling, Water pollution sources, Methodology, Acidity, Analysis, Snowpacks, Foreign research, On-site investigations, \*Ontario(Canada).

The snowpack that accumulated in central Ontario in the winter of 1977-78 had a pH of 4.0-4.5. The resultant runoff in the following spring in three intensively studied watersheds was characterized by a 2-13-fold increase in H(+) content. Between 36 and 77% of the year's export of H(+) from the watersheds occurred in April. Similar pH depressions were observed in almost all of 17 other streams that were less frequently sampled and in the littoral zones, surface waters, and outflows of 5 lakes. (Humphreys-ISWS)  
W80-00076

**BOUNDARY ELEMENT METHOD FOR FLUID FLOW,**  
Southampton Univ. (England). Dept. of Civil Engineering.  
For primary bibliographic entry see Field 8B.  
W80-00083

**GREAT LAKES BEGINNING-OF-MONTH WATER LEVELS AND MONTHLY RATES OF CHANGE OF STORAGE,**  
National Oceanic and Atmospheric Administration, Ann Arbor. MI. Great Lakes Environmental Research Lab.  
F. H. Quinn, J. A. Derecki, and R. N. Kelley.  
Journal of Great Lakes Research, Vol. 5, No. 1, p 11-17, 1979. 2 fig, 9 tab, 11 ref.

Descriptors: \*Great Lakes, \*Water levels, \*Storage, Data processing, Analytical techniques, Fluctuations, Water level fluctuations, Variability, Lakes, Water storage, Water resources, Water supply, Gages, Gaging stations, Limnology, \*Lake St. Clair.

Time series of beginning-of-month water levels and rates of change of lake storage were determined for each of the Great Lakes and Lake St. Clair for 1941-1975 period. The Thiessen polygon procedure was used to compute the beginning-of-month levels because it provides more representative overall lake levels than straight averaging and requires minimum subjectivity. The effect of crustal movement on the rate of change of lake storage was investigated and found to be negligible. A gage density analysis showed good agreement between various size gage networks with the maximum deviation between networks decreasing with increasing gage density. Thiessen polygon weighting factors were presented for the current gage networks to enable future extension of the time series. (Sims-ISWS)  
W80-00087

**DIAGENESIS OF ORGANIC MATTER IN THE SEDIMENTS OF LAKES ONTARIO, ERIE, AND HURON,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 2K.  
W80-00088

**HYPOLIMNETIC OXYGEN DEPLETION IN CENTRAL LAKE ERIE: HAS THERE BEEN ANY CHANGE,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
M. N. Charlton.  
Scientific Series No. 110, 1979, 24 p, 11 fig, 3 tab, 3 ref, 2 append.

Descriptors: \*Lake Erie, \*Hypolimnion, \*Oxygen, \*Eutrophication, \*Temperature, \*Mesotrophy, Lake morphology.

A new analysis of hypolimnetic oxygen in central Lake Erie indicates that historic increases in the apparent depletion were not as great as formerly believed. The differences that did occur were mostly related to variations in hypolimnion thickness. Changes, if any, in the oxygen depletion rate due to eutrophication are as yet too small to be recognized. Present-day oxygen depletion rates, when corrected for the relatively high temperatures in Lake Erie, are within the range thought to be indicative of mesotrophy in small lakes. The general level of oxygen depletion observed in the Central Basin of Lake Erie is expected on the basis of morphology alone. (WATDOC)  
W80-00197

**PERSPECTIVES ON LAKE ECOSYSTEM MODELING,**  
Ann Arbor Science Publishers Inc., Michigan, 1979. 326 p, Scavia, D., and Robertson, A. (Eds.).

Descriptors: \*Lakes, \*Ecosystems, \*Model studies, \*Aquatic environment, \*Great Lakes, \*Simulation analysis, \*Management, \*Water quality, \*Research needs, Phytoplankton, Zooplankton, Planning, Sampling, Hydrodynamics, Food chains, Equations, Systems analysis, Cost minimization, Hazardous substances, Resource management.

Modeling should be an integral part of both basic research and applied management programs for aquatic ecosystem study. This book consists of papers which consider lake ecological model usage, possible model improvements, and new directions for development. Most of the papers included have been taken from a special symposium on ecological modeling at the 20th Conference on Great Lakes Research at the University of Michigan in 1977. The book is divided into four sections, each dealing with an individual area of aquatic ecosystem research and the role of models in that area. Section One, Improved Model Components, considers: scale in modeling large aquatic ecosystems; an experimental and modeling review of water column death and decomposition of phytoplankton; zooplankton grazing in simulation models—the role of vertical migration; and mathematical modeling of phosphorus dynamics. Section Two, Identification of Research Needs Through Model Studies, considers: Modifications to the model Cleaner; and the use of ecological lake models in information synthesis. Section Three, Models in Management, contains: Predictive water quality models for the Great Lakes; empirical lake models for phosphorus; and a least-cost surveillance plan for water quality trend detection in Lake Michigan. Section Four, New Directions in Ecosystem Analysis, presents: preliminary insights into a three-dimensional ecological-hydrodynamic model; study of ecosystem properties of Lake Ontario using an ecological model; and an analysis of PCB in Lake Ontario using a size-dependent food chain model. (See W80-00204 thru W80-00216) (Bell-Graf-Cornell)  
W80-00204

**CONSIDERATIONS OF SCALE IN MODELING LARGE AQUATIC ECOSYSTEMS,**  
State Univ. of New York at Albany. Dept. of Biological Sciences.  
D. C. McNaught.  
In: Perspectives on Lake Ecosystem Modeling. p 3-24, 1979. 4 fig, 5 tab, 29 ref.

Descriptors: \*Lakes, \*Ecosystems, \*Model studies, \*Aquatic environment, \*Plankton patchiness, \*Data interpretation, \*Spatial-temporal scales, Distribution, Standing crops, Nutrients, Great Lakes, Excretion, Grazing, Biomass, Fish, Zooplankton, Phytoplankton, Systems analysis.

Scales of phytoplankton and zooplankton distributions characteristic of large lakes have been described and the most common ones related to causal factors. Phytoplankton aggregations were characterized by scales of hundreds of meters and tens of kilometers. Examples from small lakes ten-

tatively suggested the existence of smaller scales (meters and centimeters). Zooplankton distributions in the Laurentian Great Lakes were characterized by scales of meters, while longer scales have not been observed, probably because sampling programs that would detect them have not been carried out. Scales for fishes and zooplankton were similar, and thus at least the physical mechanisms controlling their distributions are likely the same. Spatial-temporal interactions may serve to magnify small-scale differences in plant or animal densities and associated fluxes. Coincidence in spatial-temporal scales is necessary for heterogeneity to lead to functional interrelationships between phytoplankton, zooplankton and planktonphagous fishes. Information on the scales of spatial-temporal heterogeneity for important trophic components is vital to model calibration. (See also W80-00204) (Bell-Graf-Cornell)  
W80-00205

**WATER COLUMN DEATH AND DECOMPOSITION OF PHYTOPLANKTON: AN EXPERIMENTAL AND MODELING REVIEW,**  
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.  
J. V. DePinto.  
In: Perspectives on Lake Ecosystem Modeling. p 25-52, 1979. 7 fig, 83 ref.

Descriptors: \*Ecosystems, \*Phytoplankton, \*Biomass, \*Lakes, \*Simulation analysis, \*Experiments, \*Phytoplankton-decomposition interactions, Mathematical models, Systems analysis, Algae, Nutrients, Eutrophication, Decay, Respiration, Regeneration, Death, Water column, Chemical processes, Biological processes.

Discussed is the importance of a component of ecosystem models often neglected: Phytoplankton-decomposition interactions. Results from field and laboratory studies are used to illustrate the importance of decomposers in controlling phytoplankton biomass and dynamics and thus to highlight the danger in a superficial treatment of the decomposers. Deterministic phytoplankton models are basically an ordered framework of mechanistic or semiempirical submodels. The success of a given model depends on the inclusion of all important submodels and the means used to mathematically describe a given process. Discussed is the bacteria-mediated decomposition of phytoplankton and related organic matter and the subsequent remineralization of algal growth-regulating nutrients. Reviewed are the latest attempts by modelers to respond to the inadequate understanding of and attempts to describe these processes. The building of submodels for death and decomposition of algae in the water column. These processes appear to be more significant in highly productive eutrophic lakes. Research suggests that estimates of biological losses from phytoplankton biomass in lakes must include algal respiration, natural algal mortality, microbial-induced algal mortality, and grazing by higher trophic organisms. The criterion for success or failure should depend on qualitative knowledge and direct measurement of the processes involved. (See also W80-00204) (Bell-Graf-Cornell)  
W80-00206

**ZOOPLANKTON GRAZING IN SIMULATION MODELS: THE ROLE OF VERTICAL MIGRATION,**  
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.  
J. A. Bowers.  
In: Perspectives on Lake Ecosystem Modeling. p 53-73, 1979. 3 fig, 3 tab, 3 equ, 72 ref.

Descriptors: \*Zooplankton, \*Model studies, \*Simulation analysis, \*Grazing, \*Effects, \*Vertical migration, \*Ecology, \*Lakes, Plankton, Temperature, Depth, Lake Michigan, Equations, Herbivores, Endogenous cycles, Ingestion rate, Chlorophyll concentration, Systems analysis.

Examined is the relationship between vertical migration and grazing in zooplankton. Laboratory and field data are used to illustrate and describe the influence of migration and several previously pub-

lished models of migration are described. Vertical migration complicates the simulation of grazing pressure in time and space; needed is a comprehensive theory explaining the evolution, controlling factors, and adaptive advantages of these migrations. Presented are the approaches taken by two often opposing groups—the modelers and the ecologists. Discussed are: (1) grazing equations in simulation models; (2) diel vertical migration; (3) models incorporating vertical migration; (4) vertical distribution of phytoplankton; and (5) the effects of depth position and endogenous cycles. It is concluded that modelers and zooplankton ecologists have much to offer each other when dealing with vertical migration. Modeling provides a reasonable approach to assess the implication of errors which result in hypotheses where generalizations and conclusions are intuitively difficult. Future hypotheses must include nitrogen and phosphorus excretion, size selective feeding and migration as an avoidance behavior from vertebrate and invertebrate predators; this will benefit most from the use of models as investigatory tools. (See also W80-00204) (Bell-Graf-Cornell)

W80-00207

#### MATHEMATICAL MODELING OF PHOSPHORUS DYNAMICS THROUGH INTEGRATION OF EXPERIMENTAL WORK AND SYSTEM THEORY.

Canada Centre for Inland Waters, Burlington (Ontario).  
E. Halfon.

In: Perspectives on Lake Ecosystem Modeling. p 75-83, 1979. 4 fig, 2 tab, 13 ref.

Descriptors: \*Phosphorus, \*Model studies, \*Freshwater, \*Simulation analysis, Equations, Systems analysis, Ecosystems, Experiments, Model order estimation, Parameter estimation, Behavior, Model compartments, Transfer function, Weighting factor.

System theory provides the basis for modeling and simulation; experimental work provides the data necessary to validate the model. Model order estimation and parameter estimation techniques have been used to develop a theoretical model of phosphorus dynamics in freshwater, based on work by Lean (1973). Results indicate that a model less aggregated than that proposed by Lean is more adequate. Specifically, particulate phosphorus should be modeled with more than one compartment. (See also W80-00204) (Bell-Graf-Cornell) W80-00208

#### MODIFICATIONS TO THE MODEL CLEANER REQUIRING FURTHER RESEARCH.

Rensselaer Polytechnic Inst., Troy, NY. Center for Ecological Modeling.  
R. A. Park, T. W. Groden, and C. J. Desormeau.

In: Perspectives on Lake Ecosystem Modeling. p 87-108, 1979. 3 fig, 1 tab, 97 ref.

Descriptors: \*Phosphorus, \*Model studies, \*Simulation analysis, \*MS CLEANER, \*Process-level research, \*Aquatic environment, \*Ecosystems, \*Systems analysis, \*Model structure, Research needs, Biological realism, Phytoplankton, Decomposers, Zooplankton, Fish, Sediments, Lakes.

Demonstrated is the application of systems theory techniques to identify the appropriate structure for a model, in this case a model simulating phosphorus cycling. The model structure herein indicates that in addition to those components usually deemed important, other phosphorus fractions are important in the dynamics of the phosphorus cycle. The recent trend in ecological modeling has been to include more biological realism. A result has been MS CLEANER, one of the more complex and biologically realistic ecosystem models. Current research with this model has suggested that continued model development is limited by the state of knowledge in aquatic ecology. Three levels of research are needed: (1) process-level research (special experiments to aid in formulation of constructs representing environmental responses for specific processes); (2) detailed measurements to determine parameter values for old and new constructs; and (3) comprehensive studies at ex-

perimental sites. This chapter focuses on the first of these, felt to have the greatest impact on modeling. Emphasized are those research areas of particular concern in the current development of MS CLEANER. Considered are: (1) phytoplankton (light and temperature limitation, nutrient limitation, mortality, and sinking); (2) decomposers (colonization, and uptake of organic and inorganic materials); (3) zooplankton (starving and resting states, and excretion); (4) fish (adaptive prey preference, and migration) and (5) sediments. (See also W80-00204) (Bell-Graf-Cornell) W80-00209

#### THE USE OF ECOLOGICAL MODELS OF LAKES IN SYNTHESIZING AVAILABLE INFORMATION AND IDENTIFYING RESEARCH NEEDS.

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
D. Scavia.

In: Perspectives on Lake Ecosystem Modeling. p 109-168, 1979. 6 fig, 2 tab, 23 eq, 223 ref.

Descriptors: \*Ecology, \*Lakes, \*Mathematical models, \*Aquatic environment, \*Research, Nutrients, Phytoplankton, Zooplankton, Bacteria, Fish, Sediments, Hydrodynamics, Systems analysis, Simulation analysis, Equations, Trophic, Process constructs.

Discussed are the major subdivisions of aquatic ecosystems, in terms of the constructs used to represent them in several ecological models and the experimental information used to support these constructs. Weaknesses in our understanding of these components, as identified by the state of present models, are considered, and research priorities to remove these weaknesses are recommended. The development of aquatic ecological modeling programs often minimizes the importance of identifying and setting research priorities; this chapter focuses specifically on research areas that presently represent blocks to further model development and suggests a hierarchical priority system. The models reviewed are restricted to those developed over the past decade that address the trophic ecology of the aquatic system (i.e., food chain simulation models). Discussed are: (1) nutrients (phosphorus, nitrogen, carbon, silicon, and nutrient recycling); (2) phytoplankton, including functional groups (physiology, size) and process constructs (uptake/growth, respiration, sinking, luxury consumption); (3) zooplankton, also including functional groups and process constructs (consumption, selective feeding, respiration); (4) bacteria; (5) fish; (6) sediment; and (7) hydrodynamics. The final section considers research needs, wherein information gaps lie within three categories: (1) component descriptions; (2) process constructs; and (3) coefficient values. Discussed are numerous components from category 1, including silicon cycling, multiple nutrient limitation, grazing, and field observations of process rates. These components have not yet been described quantitatively in terms of their interrelationships within the whole system. (See also W80-00204) (Bell-Graf-Cornell) W80-00210

#### PREDICTIVE WATER QUALITY MODELS FOR THE GREAT LAKES: SOME CAPABILITIES AND LIMITS.

McMaster Univ., Hamilton (Ontario).  
W. J. Snodgrass.

In: Perspectives on Lake Ecosystem Modeling. p 171-191, 1979. 3 fig, 19 ref.

Descriptors: \*Water quality, \*Model studies, \*Great Lakes, \*Management, Assessment, Nutrients, Simulation analysis, Eutrophication, Systems analysis, Decision making, Model adequacy, Model development, Modeling framework, \*Prediction, Box approach.

A major concern of water quality managers is the eutrophication of the Great Lakes. Presented is a framework for assessing some capabilities and limitations of predictive water quality models. Using this framework, several such models are critiqued: these are fundamental quantitative models describ-

ing part or all of the St. Lawrence Great Lakes System. Their objectives are (1) to provide a useful predictive basis for making decisions concerning water quality management alternatives and/or (2) to describe mathematically the most important interactions between various nutrient cycles and biological species. The framework describes the modeling process as consisting of six steps: definition of model objectives, system discretization, model construction, model calibration, model verification and model prediction. It is concluded that the box approach for modeling lakes is a useful and verified approach for considering spatial scales of the whole lake and temporal scales on the order of a year. (See also W80-00204) (Bell-Graf-Cornell) W80-00211

#### EMPIRICAL LAKE MODELS FOR PHOSPHORUS: DEVELOPMENT, APPLICATIONS, LIMITATIONS AND UNCERTAINTY.

Michigan State Univ., East Lansing. Dept. of Resource Development.  
K. H. Reckhow.

In: Perspectives on Lake Ecosystem Modeling. p 193-221, 1979. 3 fig, 7 tab, 34 eq, 28 ref.

Descriptors: \*Lakes, \*Phosphorus, \*Model studies, \*Statistical methods, \*Simulation analysis, \*Error analysis, \*Black box models, Probability, Systems analysis, Equations, Evaluation, Lake classification, Model comparison, Uncertainty, Empirical models, Management.

As opposed to ecosystem simulation models, which are complex and designed to describe the interactions among the components of the aquatic ecosystem, black box or empirical models are highly aggregated and are designed to examine the concentration (or its annual changes) of a single component, generally phosphorus or chlorophyll *a*. They are developed from multi-lake, cross-sectional analyses, yet are often applied for single-lake, longitudinal prediction (forecasting over time) purposes. Each of these two basic types of lake models is useful in the understanding and management of lake ecosystems; it is important to understand the uses and limitations of each model type. Traced herein is the development of simple black box or empirical phosphorus lake models. A number of approaches is examined, criteria are suggested for model evaluation and discrimination, and the limitations of each model are outlined. Described is the use of first-order uncertainty analysis for establishing bounds on predictions made by mathematical models. The error analysis is used to compare prediction confidence among the models of total phosphorus dynamics presented. These models may prove most useful in (1) suggesting general trends in lake quality, (2) providing a quick assessment of quality and a first cut at phosphorus 'carrying capacity' for a number of lakes, and (3) introducing useful quantitative techniques to planners and decision makers in lake management who have not previously applied mathematical models. (See also W80-00204) (Bell-Graf-Cornell) W80-00212

#### PRELIMINARY INSIGHTS INTO A THREE-DIMENSIONAL ECOLOGICAL-HYDRODYNAMIC MODEL.

Tetra Tech, Inc., Lafayette, CA.  
C. W. Chen, and D. J. Smith.

In: Perspectives on Lake Ecosystem Modeling. p 249-279, 1979. 23 fig, 2 tab, 23 ref.

Descriptors: \*Hydrodynamics, \*Ecology, \*Model studies, \*Lake Ontario, \*Aquatic environment, \*Water quality, \*Simulation analysis, Feasibility, Great Lakes, Currents(Water), Velocity, Annual, Daily, Temperature, Dissolved oxygen, Algae, Mass transport, Heat transfer, Biological changes, Chemical reactions, Systems analysis.

As part of the data analysis program for the International Field Year for the Great Lakes, a comprehensive water quality-ecological model for Lake Ontario has been developed. The model simulates mass transport, heat transfer, biological transformations and chemical reactions and provides an integrated interpretation of physical, chemical and biological data observed in the field. This paper

## Field 2—WATER CYCLE

### Group 2H—Lakes

presents the model, the preliminary simulation results and information gained from the modeling effort. The authors explore the feasibility of coupling a relatively sophisticated ecosystem model with a complex hydrodynamic model in order to simulate the above properties of a lake in three dimensions of space as well as the fourth of time. The Lake Ontario model is comprised of three basic modules: hydrodynamic, interface, and water quality. (See also W80-00204) (Bell-Graf-Cornell) W80-00214

**THE EXAMINATION OF ECOSYSTEM PROPERTIES OF LAKE ONTARIO THROUGH THE USE OF AN ECOLOGICAL MODEL.**  
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
A. Robertson, and D. Scavia.  
In: Perspectives in Lake Ecosystem Modeling. p 281-292, 1979. 4 fig, 5 tab, 8 ref.

Descriptors: \*Lake Ontario, \*Ecosystems, \*Mathematical models, \*Great Lakes, \*Simulation analysis, \*Value, Atmosphere, Hypolimnion, Epilimnion, Sediments, Concentrations, Seasonal, Trophic level, Efficiencies, Carbon budgets, Herbivores, Carbon cycling diagrams, Turnover times, Systems analysis.

There has been little study of the usefulness of models for understanding the basic ecological processes in the Great Lakes. The authors developed an ecosystem model for Lake Ontario which simulates the general features of the Ontario ecosystem quite well. Using an updated version of this model, an investigation is made herein of the utility of employing the modeling approach to study certain basic ecological properties of the system, properties which in many cases are almost impossible to examine in an ecosystem as large as Ontario with direct field measurements. Presented are examples of properties which can be investigated and attempts to evaluate the validity and usefulness of this approach for gaining insights into large ecosystems. Discussed are: carbon cycling diagrams, relative concentrations, hypolimnion/epilimnion concentration ratios, carbon budgets for separate categories, turnover times, and trophic level efficiencies of carbon intake. In conclusion, ecosystem models have substantial potential as tools for basic ecology and their use for such a purpose well deserves further investigation. (See also W80-00204) (Bell-Graf-Cornell) W80-00215

**FISHERY SURVEY OF CEDAR LAKES AND THE BRAZOS AND SAN BERNARD RIVER ESTUARIES.**  
Texas Parks and Wildlife Dept., Austin.  
R. B. Johnson, Jr.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-280 744, Price codes: A04 in paper copy, A01 in microfiche. Technical Series No. 23, 1977. 65 p, 23 fig, 9 tab, 18 ref, 1 append.

Descriptors: \*Fisheries, \*Sampling, \*Census, \*Estuaries, \*Freshwater, Invertebrates, Fish, Texas, Lakes, Rivers, Wetlands, Aquatic habitats, Estuarine fisheries, Marine fisheries, Freshwater fish, Commercial fishing, Sport fishing, Water properties, Salinity, Water temperature, Dissolved oxygen, Hydrogen ion concentration, Turbidity, Water pollution, Trawling, Dredging, Nets.

A fishery study of Cedar Lakes and the lower parts of the Brazos and San Bernard Rivers, Texas, was conducted from February 1973 to January 1975. Samples were collected at 17 stations each month to determine hydrological conditions and occurrence of estuarine organisms. Salinity, temperature, dissolved oxygen values, pH values, and turbidity were determined in surface and bottom water samples. Of 146 species of fish and invertebrates observed or caught in the study area, 35 were marine species which contribute to Texas' recreational and commercial fisheries. An annotated checklist is presented. Vital fisheries habitat is identified. Pollution in the lower Brazos River has eliminated 9.8 to 21.1 km (depending upon

weather conditions) of stream bottom from substantial fisheries production. Information collected was also used to map 'nursery' habitat of 10 species of fish and crustaceans of economic value. (Bollinger-Mass) W80-00305

**VEGETATION CHANGES IN A SHALLOW AFRICAN LAKE: RESPONSE OF THE VEGETATION TO A RECENT DRY PERIOD.**  
Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.  
C. Howard-Williams.  
Hydrobiologia, Vol. 47, No. 3-4, p 381-397, December 1, 1975. 3 fig, 5 tab, 28 ref.

Descriptors: \*Lakes, \*Vegetation, \*Droughts, \*Stability, Mud flats, Lake beds, Lake basins, Salinity, Biota.

Changes in vegetation on the lake bed of a shallow African lake in response to a dry period consisted of a pre-drying, dry, refilling, and post-filling stage. During pre-drying, *Typha domingensis* predominated the lake margins. *Diplachne fusca*, *Cyperus laevigatus*, and *Aeschynomene pfundii* survived on the mud flats characterized by alkaline clays in the basin during the dry phase. Almost pure stands of *Diplachne fusca* and *Aeschynomene pfundii* occurred as new vegetation during the refilling phase. However, opposite river inflows and on sandy soils, a variety of species developed. During the post-filling stage *Cyperus laevigatus*, *Diplachne fusca* and *Aeschynomene pfundii* died as the waters rose. The lake margins once again reverted to the pre-drying phase vegetation of *Typha*. Due to the lake's rapid recovery (inside two years) of its biota after the dry period, it may have a high degree of biological stability. *Aeschynomene pfundii* thrived in deep water but was unable to regenerate since seed germination could not occur underwater. The salinity of the lake during low water and drying period prevented *Typha domingensis* from colonizing the lake bed extensively. (Ottello-Mass) W80-00313

**EFFECTS OF A DRAWDOWN ON A WATERFOWL IMPOUNDMENT.**  
Michigan Dept. of Conservation, Lansing. Rose Lake Wildlife Experiment Station.  
J. A. Kadlec.  
Ecology, Vol. 43, No. 2, p 267-281, Spring, 1962. 8 fig, 5 tab, 46 ref.

Descriptors: \*Drawdown, \*Water levels, \*Impoundments, \*Waterfowl, Mallard ducks, Black ducks, Blue-winged teal, Soil analysis, Water analysis, Invertebrates, Vegetation.

A pilot drawdown on the Backus Lake flooding project in north-central lower Michigan was evaluated during the summer of 1958 along with its effect on vegetation, waterfowl, soil, water, and bottom fauna. Plant species composition was not notably affected. Common perennials were able to survive drainage for one growing season. Many submerged and floating-leaf species were reduced in abundance. Water lilies were little affected except in severely dried areas. Water smartweed and bushy pondweed grew luxuriantly after the drawdown. Most emergents spread and increased in abundance. Sedges and woollgrasses were most abundant on dry portions of the study area. Cattail, bulrush, and burreed were more abundant where soil moisture was returned throughout the drawdown. Rice cutgrass and manna grasses were generally distributed. Waterfowl utilization of the area increased in late summer 1959. Abundant food attracted ducks, and increased cover caused increased use by breeding waterfowl in 1960. Soil and water analyses indicated a definite increase in plant nutrients, especially soil nitrates due to aerobic nitrification. Invertebrate populations were considerably reduced after the drawdown. (Ottello-Mass) W80-00315

**MINNESOTA PEAT PROGRAM: MANAGEMENT GOALS AND OBJECTIVES AND POLICY ALTERNATIVES.**

For primary bibliographic entry see Field 6A. W80-00316

**PEATLAND POLICY STUDY.**  
Minnesota Univ.-Duluth.  
For primary bibliographic entry see Field 6E. W80-00317

**NITROGEN DYNAMICS AND MODELING IN A FRESHWATER WETLAND.**  
Michigan Univ., Ann Arbor.  
For primary bibliographic entry see Field 2K. W80-00327

**INSTALLATION AND OPERATION OF THE DEE TELEMETRY SYSTEM.**  
Welsh National Water Development Authority, Cardiff (Wales).  
For primary bibliographic entry see Field 7B. W80-00332

**CAPITAL AND OPERATING COSTS OF THE EXISTING DEE RADAR, TELEMETRY AND FLOW FORECASTING PROJECT.**  
Water Resources Board, Reading (England).  
For primary bibliographic entry see Field 7B. W80-00333

**REAL-TIME CONVERSION OF RAINFALL TO RUNOFF FOR FLOW FORECASTING IN THE RIVER DEE.**  
Institute of Hydrology, Wallingford (England).  
For primary bibliographic entry see Field 2E. W80-00334

**CONTROL RULES FOR LONG AND SHORT TERM OBJECTIVES.**  
Welsh National Water Development Authority, Chester (England).  
For primary bibliographic entry see Field 2E. W80-00335

**ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS (1968) AND SEDIMENT CORES (1976) FROM LAKE ONTARIO.**  
Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab.  
For primary bibliographic entry see Field 5A. W80-00341

**MASS EXCHANGE BETWEEN HAMILTON HARBOUR AND LAKE ONTARIO.**  
Ontario Ministry of the Environment, Toronto. Water Resources Branch.  
B. Kohli.  
Journal of Great Lakes Research, Vol. 5, No. 1, p 36-44, 1979. 10 fig, 5 tab, 16 ref.

Descriptors: \*Mass transfer, \*Harbors, \*Lakes, \*Lake Ontario, Currents (Water), Flow, Dissolved oxygen, Dissolved solids, Water temperature, Canals, Inlets (Waterways), Circulation, Water circulation, On-site investigations, Measurement, Current meters, Temperature, Data processing, Limnology.

The mass exchange between Hamilton Harbour and Lake Ontario waters through the Burlington Canal is important for estimating the dissolved oxygen budget of the harbor. Lake-harbor exchange is caused by either the oscillatory flow in the canal during isothermal conditions or the densimetric flow during thermal stratification. During the study period (September 1975), the canal water was found to be quasi-isothermal; consequently, oscillatory flow existed. A computational method was developed to estimate the exchange based on excursion distance travelled for each limnological episode, and the final flow in each direction was checked with dissolved solids budget. An average of 2,040,000 cu m/d (24 cu m/s) of harbor water is estimated to flow into the lake, while 730,000 cu m/d (8 cu m/s) of lake water flowed toward the harbor during September 1975. This accounts for

## Water in Plants—Group 21

the total and net daily exchange of 0.98% and 0.48% of harbor volume, with net exchange being toward the lake. The total and net exchanges were, respectively, 8 and 4 times the natural drainage during the study period. On a monthly average, more water leaves than enters the harbor. The lake-harbor exchange is considered important for maintaining and even improving the existing harbor water quality. The harbor dilution factor was estimated as 0.0019 per day for the present study. (Sims-ISWS)  
W80-00343

**RELATIVE ACCURACY OF CONNECTING CHANNEL DISCHARGE DATA WITH APPLICATION TO GREAT LAKES STUDIES.**  
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.  
For primary bibliographic entry see Field 2E.  
W80-00347

**INFLUENCE OF NEARSHORE TILL LITHOLOGY ON LATERAL VARIATIONS IN COASTLINE RECESSION RATE ALONG SOUTH-EASTERN LAKE MICHIGAN.**  
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2J.  
W80-00348

## 21. Water in Plants

**CONTRIBUTION TO THE STUDY OF SOME BRYOASSOCIATIONS OF THE SUBALPINE ZONE IN THE SOUTHEAST OF FRANCE (CONTRIBUTION A L'ETUDE DE QUELQUES BRYOASSOCIATIONS DE L'ETAGE SUBALPINE DANS LE SUD-EST DE LA FRANCE).**  
Centre National de la Recherche Scientifique, Marseille (France). Lab. de Botanique.  
J. P. Hebrard.  
Vegetatio, Vol. 27, No. 4-6, p 347-381, June 28, 1973. 10 tab, 67 ref.

Descriptors: \*Bogs, \*Vegetation, \*Ecological distribution, Mountains, France, Wetlands, Ecology, Mosses, Peat.

Descriptions are provided of the various vegetative associations found on siliceous rocks, cozing gneiss walls, and calcareous rocks in the subalpine district of the high mountains of southern France. The peat-bogs with *Sphagnum* spp. and members of the genera *aulacomnium* and *meesia* seem to be particular to the old crystalline chain where they were found at an altitude of 1900 meters. Calcareous or flysch-bogs present a cryptogamic vegetative association. (Howard-Mass)  
W80-00006

**WATER RELATIONS OF THREE MANGROVE SPECIES IN SOUTH FLORIDA.**  
San Diego State Univ., CA. Dept. of Biology.  
P. C. Miller, J. Hom, and D. K. Poole.  
Oecologia Plantarum, Vol. 10, No. 4, p 355-367, 1975. 4 fig, 1 tab, 34 ref.

Descriptors: \*Mangrove swamps, \*Plant physiology, \*Moisture deficit, Wetlands, Metabolism, Osmotic pressure, Water balance, Turgidity.

Water potentials measured with a pressure bomb were similar to those measured with thermocouple psychrometers in *Avicennia germinans* and *Laguncularia racemosa* but not in *Rhizophora mangle* at high water potentials. Total leaf potentials decreased rapidly with increasing water deficit in *Avicennia*, more gradually in *Laguncularia* and after some delay in *Rhizophora*. Osmotic potentials decreased, as water deficit increased, more rapidly in *Avicennia* than the others. Turgor potentials decreased rapidly in increasing water deficit in *Avicennia*, more gradually in *Laguncularia* and after a delay in *Rhizophora*. All three mangroves showed a small change in water deficit of branches at relatively high water potentials, a large change at intermediate potentials, and a small change at

low potentials, but the pattern varied among the species. Leaf conductance to water loss decreased more rapidly in *Avicennia* than in *Laguncularia*. Conductance of *Rhizophora* increased as relative water deficit increased to 3% to 4%, then decreased. Minimum conductances in the field were 0.2 to 0.5 cm/sec. The differences in water relations are suggested to be related to the differences in mechanisms of salt balance and leaf morphology. (Steiner-Mass)  
W80-00009

**COMPARATIVE ECOLOGICAL REQUIREMENTS OF A PERENNIAL AND AN ANNUAL SALICORNIA SPECIES: GERMINATION AND GROWTH DURING THE EARLY STAGES OF DEVELOPMENT, (IN FRENCH).**  
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.  
M. Grouzis.  
Oecologia Plantarum, Vol. 8, No. 4, p 367-375, 1973. 3 fig, 16 ref. (English summary).

Descriptors: \*Salicornia, \*Germination, \*Halophytes, Marsh plants, Distribution patterns, Plant growth, Vegetation establishment, Seeds, Salt tolerance.

Two halophytes, widely spread over the French Mediterranean coastal zone, *Salicornia emeri* and *Salicornia frutescens*, have adopted different evolutionary strategies. *S. emeri* is annual and colonizes the bare silt surfaces where every year numerous seedlings are observed. *S. frutescens* is perennial and develops a dense persistent vegetation cover characteristic of a mature ecosystem. This species also produces numerous seeds, but seedlings are found only occasionally. Studies were made under laboratory conditions of the effects of pretreatment of the seeds on germination and of salinity of the substrate on growth during the early stages of development. Results show that salinity of the substrate inhibits seed germination in *S. emeri*, but not in *S. frutescens*. Cold treatment in humid air is not required either for germination in the latter species. At the same time, the two species respond in a similar manner to salinity during the early stages of growth. Therefore, scarceness of *S. frutescens* seedlings seems not to be related to some intrinsic property of the seed. (Steiner-Mass)  
W80-00010

**SEASONAL CHANGES OF PHRAGMITES COMMUNIS TRIN. PART I. GROWTH, MORPHOMETRICS, DENSITY AND BIOMASS.**  
Polish Academy of Sciences, Warsaw. Dept. of Biocenology.  
H. Mochacka-Lawacz.  
Polskie Archiwum Hydrobiologii, Vol. 21, No. 3/4, p 355-368, 1974. 7 fig, 2 tab, 20 ref.

Descriptors: \*Marsh plants, \*Growth rates, \*Biomass, Wetlands, Lakes, Distribution patterns, Density, Plant growth, Plant morphology.

During two vegetation seasons the growth rates, morphometrics, density, and biomass of five reedbeds on lakes near Mikolajki, Poland, were compared. Besides the differences between the reedbeds, large differences were also found between reed growing on the shore, in the middle, and on the edge of the reedbeds. In this connection, the reedbeds were classified into three types: undifferentiated, differentiated in one direction, and irregularly differentiated. It was found that the reeds growing in the shore parts of the reedbeds, only periodically inundated with water, were characterized by the lowest values of the variables measured. (Steiner-Mass)  
W80-00011

**COMMUNITY PLANKTON RESPIRATION IN A SALT MARSH ESTUARY AND THE IMPORTANCE OF MACROPHYTIC LEACHATES.**  
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.  
R. E. Turner.  
Limnology and Oceanography, Vol. 23, No. 3, p 442-451, May, 1978. 7 fig, 4 tab, 37 ref.

Descriptors: \*Salt marshes, \*Plankton, \*Respiration, Rooted aquatic plants, Biological communities, Temperature, Salinity, Water levels, Seasonal, Fluctuation, Estuary, Wetlands, Marshes, Organic matter, Leaching, Biomass, Georgia.

Community plankton respiration (CPR) in a Georgia salt marsh tidal creek and estuary ranged from 94 to 162 g O<sub>2</sub>/cu m/year inshore. Values were much lower in nearby coastal waters. Seasonal changes in CPR are closely associated with changes in temperature in a log-log manner as are many other measures of metabolic activity in the estuary, including live biomass of *Spartina alterniflora*. Leaching rates of dissolved organic matter by *Spartina* during tidal submergence were 200 to 800 micro g C/g dry wt/h depending on salinity and season. The release rate was lower, 21 micro g C/g dry wt/h, when the plant was not submerged. The plankton community is capable of rapidly and efficiently absorbing this material, which is produced in large enough quantities to account for the observed seasonal changes in CPR. (Howard-Mass)  
W80-00014

**NITROGEN FIXATION BY RHIZOSPHERE AND FREE-LIVING BACTERIA IN SALT MARSH SEDIMENTS.**  
Woods Hole Oceanographic Inst., MA.  
J. M. Teal, I. Valiela, and D. Berlo.  
Limnology and Oceanography, Vol. 24, No. 1, p 126-132, January, 1979. 5 fig, 2 tab, 18 ref.

Descriptors: \*Salt marshes, \*Sediments, \*Bacteria, \*Nitrogen fixation, Microenvironment, Microorganisms, Nitrogen cycle, Marshes, Wetlands, Ecology, Root zone, Temperature, Vegetation, Ecological distribution, Biological communities.

The rates of nitrogen fixation by rhizosphere and free-living bacteria are highest near the surface of a variety of salt marsh sediments and in the warm part of the year. The highest rates were found in vegetated habitats, reaching up to about 500 ng N.cm<sup>-2</sup>.h<sup>-1</sup>. Bacterial N<sub>2</sub> fixation for the entire marsh is more than 10 times larger than algal fixation and less than a third of the N required to support growth of the vegetation. (Howard-Mass)  
W80-00016

**AN EVALUATION OF METHODS FOR ESTIMATING THE NET AERIAL PRIMARY PRODUCTIVITY OF ESTUARINE ANGIOSPERMS.**  
Georgia Univ., Brunswick. Marine Resources Extension Center.  
R. A. Linthurst, and R. J. Reimold.  
Journal of Applied Ecology, Vol. 15, No. 3, p 919-931, December, 1978. 1 fig, 4 tab, 25 ref.

Descriptors: \*Salt marshes, \*Rooted aquatic plants, \*Productivity, \*Methodology, Estuarine environment, Wetlands, Estimating, Analytical techniques, Primary productivity, Biomass, Standing crop.

Estimated net aerial primary productivity (NAPP) of angiosperm species in coastal saltmarshes of the eastern United States varied up to tenfold when five different harvest methods were utilized. NAPP was underestimated by four methods and may have been overestimated by the remaining method. The ranking of species by NAPP, which may be used as a measure of their importance to the estuarine system, varied between methods. Morphology of the species, location, and general environmental conditions affect the results of any single method. The factors must be considered before selecting a particular harvest method. Future work should assess the precision of the methodologies. (Howard-Mass)  
W80-00017

**GROWTH AND SALT ACCUMULATION IN TWO ANNUAL SPECIES OF SALICORNIA FROM THE MEDITERRANEAN COAST, (IN FRENCH).**  
Centre National de la Recherche Scientifique, Montpellier (France). Dept. de Physiologie Ecologique.

## Field 2—WATER CYCLE

### Group 21—Water in Plants

M. Grouzis, G. Heim, and A. Berger.  
*Oecologia Plantarum*, Vol. 12, No. 4, p 307-322, 1977. 9 fig, 3 tab, 31 ref. (English summary).

Descriptors: \*Salicornia, \*Halophytes, \*Salt tolerance, Wetlands, Plant growth, Seashores.

Growth and salt accumulation were studied in two annual species of *Salicornia* living in contrasting ecological situations. *Salicornia patula* is found on heavy soils where salinity is very high while *Salicornia brachystachya* grows on coarser soils where the level of salinity is much lower. Results show that the two species are obligatorily halophytes requiring a certain salt concentration to attain full development. Comparison between their responses to salinity indicates that they differ more in their requirement in salt than by their resistance to it and their roots are less sensitive than their aerial parts to an excess as well as a lack of salt. (Steiner-Mass) W80-00018

**ADSORPTION AND ACCUMULATION OF PESTICIDES RESIDUES AND CHLORINATED BIPHENYLS IN BOTH WILD AQUATIC VEGETATION AND RICE IN THE CAMARGUE REGION, (IN FRENCH),**  
Centre National de la Recherche Scientifique, Arles (France), Centre Ecologie Camargue.  
For primary bibliographic entry see Field 5B.  
W80-00020

**ROLE OF CARBOHYDRATE IN HALOPHYTES OF THE REGION OF NEUSIEDLER LAKE, AUSTRIA, (IN GERMAN),**  
Vienna Univ. (Austria). Pflanzenphysiologisches Inst.  
R. Albert, and M. Popp.  
*Oecologia Plantarum*, Vol. 13, No. 1, p 27-42, 1978. 4 fig, 2 tab, 48 ref. (English summary).

Descriptors: \*Halophytes, \*Plant physiology, \*Carbohydrates, \*Lake Neusiedler(Austria), Wetlands, Marsh plants, Monocots, Dicots, Plant tissues, Osmotic pressure, Lakes.

The total sugar concentrations in the cell sap of monocotyledons ranged from 154 to 213 mmol./liter freshwater and far exceeded the concentrations in dicotyledons, 19 to 85 mmol./liter. Except for pronounced salt-accumulators (*Salicornia*, *Suaeda*, *Lepidium crassifolium*, *Triglochin maritimum*) the total osmotic potentials, calculated from the sum of soluble ions and carbohydrates, lie as low in monocotyledons as in most dicotyledons (-13 to -22 bars, average) in spite of restricted salt uptake of former species. Accordingly, in monocotyledons the percentages of soluble carbohydrates of the total osmotic potentials are as high as 2 to 36% while dicotyle halophytes were as low as 2 to 12%. The high sugar content of monocotyle species is considered to be of eco-physiological importance, since it makes possible the growth of such plants on saline soils having low water potential without extensive salt accumulation. (Steiner-Mass) W80-00021

**THE INFLUENCE OF SALINITY, INUNDATION AND TEMPERATURE ON THE GERMINATION OF SOME HALOPHYTES AND NON-HALOPHYTES,**  
Vrije Univ., Amsterdam (Netherlands). Biological Lab.  
J. Rozema.  
*Oecologia Plantarum*, Vol. 10, No. 4, p 341-353, 1975. 3 fig, 29 ref.

Descriptors: \*Marsh plants, \*Salt tolerance, \*Flooding, Wetlands, Ecological distribution, Salt marshes, Marsh management, Germination, Marshes, Halophytes.

The germination responses of some plant species from a Dutch salt marsh were tested in regard to salinity and flooding. A comparison was made between these species and some inland glycophytes. *Juncus maritimus* was the most salt tolerant species. *Juncus gerardii* preferred flooding conditions for the germination as, to less extent, all

investigated *Juncus* species. However, differences in salt and flooding response between the investigated halophytes and glycophytes are relatively small. Plant zonation can only partly be explained by the factors of salinity and flooding regarding germination. (Steiner-Mass) W80-00022

**SEASONAL PATTERNS OF CO<sub>2</sub> AND WATER VAPOR EXCHANGE OF JUNCUS ROEMERIANUS SCHEELE IN A GEORGIA SALT MARSH,**  
Georgia Univ., Athens. Dept. of Botany.  
J. R. Giurgevich, and E. L. Dunn.  
*American Journal of Botany*, Vol. 65, No. 5, p 502-510, May-June, 1978. 3 fig, 4 tab, 40 ref.

Descriptors: \*Salt marshes, \*Vegetation, \*Plant physiology, Productivity, Photosynthesis, Carbon cycle, Transpiration control, Respiration, Microenvironment, Environmental effects, Temperature, Georgia, Seasonal, Wetlands, Ecology.

Net photosynthesis in intact plants of *Juncus roemerianus* (black needle-rush) in an undisturbed salt marsh community on Sapelo Island, Georgia, was highest in early spring, but declined only slightly through the year. A distinct and moderate temperature optimum of net photosynthesis was observed with decreasing rates above 30 °C. Leaf conductances to water vapor were similar at all seasons and were high at cooler temperatures and decreased with increasing temperature. Transpiration was relatively high and constant during all seasons. The water-use efficiency of photosynthesis was high below 25 °C, but decreased sharply above that temperature. Dark respiration was relatively low. Seasonal changes reflected changes in leaf density. Decreasing stomatal conductances and increasing respiration rates reduced net photosynthesis at higher temperatures. The stomatal resistance increased and internal resistances to CO<sub>2</sub> uptake decreased over the year, but the total resistance remained constant. The internal resistance to CO<sub>2</sub> uptake was consistently higher than stomatal resistance. *Juncus roemerianus* is well adapted to the seasonal changes in ambient temperature, irradiance and other microenvironmental factors of the high marsh, and can maintain a high productivity in the seasonally hot and stressful environment. (Howard-Mass) W80-00023

**THE MINERAL CONTENT OF SPHAGNUM FUSCUM AS AFFECTED BY HUMAN SETTLEMENT,**  
Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology.  
E. Gorham, and D. L. Tilton.  
*Canadian Journal of Botany*, Vol. 56, No. 21, p 2755-2759, November 1, 1978. 1 fig, 5 tab, 21 ref.

Descriptors: \*Bogs, \*Nutrients, \*Mosses, \*Agriculture, \*Environmental effects, Chemical properties, Marshes, Wetlands, Freshwater marshes, Ecology, Minnesota, Aquatic plants.

Windblown soil from cultivated farmland is the chief influence upon the ash content of *Sphagnum fuscum* in ombrotrophic bogs, which are dependent upon the atmosphere for their mineral supply, in Minnesota, Wisconsin, and Saskatchewan. Bogs unaffected by human settlement and the resultant increase in the mineral supply are restricted to the wilderness areas in the northeastern part of Minnesota. *Sphagnum* serves as an effective trap for dust and is much richer in the lithophilic elements Al and Fe than the needles of tamarack from comparable habitats. Dust fall may be readily washed off the tree needles by rain. Tamarack concentrates B to a much greater degree than does *Sphagnum*. (Howard-Mass) W80-00024

**PRIMARY PRODUCTIVITY OF EMERGENT MACROPHYTES IN A WISCONSIN MARSH ECOSYSTEM,**  
Wisconsin Univ.-Milwaukee. Dept. of Botany.  
J. M. Klopatek, and F. W. Stearns.  
*American Midland Naturalist*, Vol. 100, No. 2, p

320-332, 1978. 3 fig, 5 tab, 52 ref.

Descriptors: \*Freshwater marshes, \*Marsh plants, \*Primary productivity, Wetlands, Marshes, Cattails, Seasonal, Marsh management, Standing crop, Mud flats, Rooted aquatic plants, Aquatic plants.

Primary productivity of various emergent macrophytes was examined in Theresa Marsh, a shallow, semimanaged impoundment in southeastern Wisconsin. Dominant macrophytes included *Typha latifolia*, *Scirpus fluviatilis*, *Carex lasiocarpa*, *Phalaris arundinacea*, and a shrub, *Salix interior*. Seasonal patterns of production as well as total production varied greatly among species. With estimates for litter loss and below-ground production, annual net primary production ranged from 1181 g/sq m/year for *Carex lasiocarpa* to nearly 3200 g/sq m/year for *Typha latifolia*. Peak standing crop values were generally among the highest reported. Average productivities during the growing season, however, were relatively low, ranging from 6.31 to 10.52 g/sq m/year for aboveground standing crops. Primary production was also estimated for transient species that occurred on mud flats following a marsh drawdown. The high primary production within the marsh appears to be based on high nutrient levels as indicated by the marsh water and soil chemistry. (Steiner-Mass) W80-00026

**FLORISTICS OF THE MIDDLE MISSISSIPPI RIVER SAND AND MUD FLATS,**  
Marshall Univ., Huntington, WV. Dept. of Biological Sciences.  
D. K. Evans.  
*Castanea*, Vol. 44, No. 1, p 8-24, 1979. 4 fig, 4 tab, 13 ref.

Descriptors: \*Mississippi River, \*Distribution patterns, \*Marsh plants, Rivers, Mud flats, Sand bars, Aquatic plants, Rooted aquatic plants, Illinois, Missouri, Wetlands.

Collections of vascular plants from nine study stations along the middle Mississippi River sand and mud flats in southern Illinois and southeastern Missouri were made over three growing seasons. Of 187 taxa recorded, the Graminae, Euphorbiaceae, Compositae, and Cyperaceae were, respectively, the most widespread and abundant groups. Floristic similarity coefficients of nine sites along 30 miles of shoreline ranged from 0.189 to 0.803. Line transects through representative communities indicated that six to seven species comprised 83 to 87 percent of the total relative frequencies of species encountered. Composition and distribution of river flat flora are greatly influenced by proximity of seed source, site habitat diversity, frequency and season of flooding, and chance dispersal of disseminules by water. (Steiner-Mass) W80-00028

**EMERGENT AQUATIC PLANTS IN THE UPPER OHIO RIVER AND MAJOR NAVIGABLE TRIBUTARIES, WEST VIRGINIA AND PENNSYLVANIA,**  
Army Engineer District, Pittsburgh, PA.  
M. Koryak.  
*Castanea*, Vol. 43, No. 4, p 228-237, 1978. 1 fig, 2 tab, 9 ref.

Descriptors: \*Ohio River, \*Distribution patterns, \*Aquatic plants, Rivers, Aquatic habitats, Rooted aquatic plants, Submerged plants.

A cursory examination was made of aquatic macrophyte distribution along the length of the Monongahela River, a 210 kilometer reach of the upper Ohio River, and the lower 116 kilometers of the Allegheny River where commercial navigation is maintained. Aquatic vascular plants were abundant and diverse in both the rivers. Significant qualitative differences were observed in the aquatic macroflora that may be related to basic differences in the channel morphologies and the substrates of these two rivers. Aquatic plants, at least conspicuous emergent vegetation, were not abundant in the reach of the mainstream Ohio River that was examined. (Steiner-Mass) W80-00029

## Water in Plants—Group 21

**BEACH AND SALT MARSH VEGETATION OF THE NORTH AMERICAN PACIFIC COAST,**

California Univ., Santa Barbara. Dept. of Geological Sciences.  
K. B. Macdonald, and M. G. Barbour.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 175-233, 1974. 4 fig, 9 tab, 100 ref.

Descriptors: \*Marsh plants, \*Halophytes, \*Distribution patterns, \*Pacific coast region, Wetlands, Salt marshes, Marshes, Beaches, Aquatic plants, Coastal marshes.

Some 57 species of vascular plants appear to be most characteristic of the beaches from Point Barrow, Alaska, to the tip of Baja California while over 140 species of vascular plants and a dozen macro-algae species are characteristic of the salt marshes. Species range data indicate that the composition of the salt marsh changes rather gradually with latitude and that the species represented at each locality characteristically occupy discrete vertical zones. Quantitative data indicate that while each species may reach its maximum abundance over a limited elevational range, it will also occur in lesser abundances in other elevational zones under different environmental conditions. There is also some evidence to suggest that while the more northerly marshes may be separated into high and low marsh vegetation types, the more southerly sites may contain a third distinctive vegetation type that is restricted to intermediate elevations. (Steiner-Mass)  
W80-00031

**A REVIEW OF STRUCTURE IN SEVERAL NORTH CAROLINA SALT MARSH PLANTS,**

North Carolina State Univ. at Raleigh. Dept. of Botany.  
C. E. Anderson.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 307-344, 1974. 39 fig, 25 ref.

Descriptors: \*Marsh plants, \*Halophytes, \*North Carolina, \*Plant morphology, Wetlands, Vascular tissues, Salt marshes, Plant tissues, Marshes, Grasses, Salt tolerance, Structure.

The basic structural features are presented of seven plants occurring in North Carolina salt marshes. The plants are: *Spartina alterniflora*, *Spartina patens*, *Distichlis spicata*, *Aster tenuifolius*, *Juncus roemerianus*, *Salicornia virginica*, and *Limonium* spp. Literature on related species are also presented. (Steiner-Mass)  
W80-00032

**SALT TOLERANCE OF MANGROVES AND SUBMERGED AQUATIC PLANTS,**

Texas Univ. at Austin. Plant Ecology Research Lab.  
C. McMillan.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 379-390, 1974. 3 tab, 23 ref.

Descriptors: \*Mangrove swamps, \*Submerged aquatic plants, \*Salt tolerance, Wetlands, Swamps, Halophytes, Aquatic plants, Marine plants, Salinity.

Mangroves and submerged aquatic plants share a niche attribute of tolerance to broad and rapid changes in salinity. Among five seagrasses studied, *Halodule*, which often occurs as the sole occupant of shallower and more hypersaline bays, has the greatest tolerance of salinity. *Cymodocea* and *Halophila* have the narrowest tolerance ranges, and *Ruppia* is the only one that can survive for extended periods in nonsaline conditions. In order of their decreasing tolerance to low salinity, the five seagrasses are: *Ruppia*, *Halodule*, *Thalassia*, *Cymodocea*, and *Halophila*. The mangroves also survived rapid changes in salinity but among three species studied, narrower tolerances were shown by *Rhizophora* and *Laguncularia* than by *Avicennia*. All survive for indefinite periods in nonsaline conditions. Among *Avicennia* plants, those of various age or stage of development showed differ-

ent salt tolerance. Seedlings and younger plants had greater tolerance to hypersaline conditions. (Steiner-Mass)  
W80-00033

**MATHEMATICAL MODELING—SPARTINA,**

Georgia Univ., Sapelo Island. Marine Inst.  
R. J. Reimold.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 393-406, 1974. 7 fig, 3 tab, 34 ref.

Descriptors: \*Marsh plants, \*Mathematical models, \*Phosphorus, Wetlands, Salt marshes, Grasses, Model studies, Marsh management, Halophytes.

A five compartment mathematical model is presented to examine discrete changes in *Spartina alterniflora*, the salt marsh cordgrass. A portion of the research focused on mathematical manipulation of the model, the other on field validation of the mathematical manipulation. The initial results of the model over four years demonstrate that there is a periodicity in each of the compartments and that it assumes a logical sequence. An increase in phosphorus in *Spartina* is followed by an increase in the detritus and water compartments. The sediment compartment contains most of the standing stock of phosphorus and gives the stability to the rest of the system. (Steiner-Mass)  
W80-00034

**PROBABLE AGENTS FOR THE FORMATION OF DETRITUS FROM THE HALOPHYTE, SPARTINA ALTERNIFLORA,**

Brunswick Junior Coll., GA.  
M. S. May, III.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, N.Y., p 429-440, 1974. 4 fig, 18 ref.

Descriptors: \*Marsh plants, \*Detritus, \*Marine fungi, Wetlands, Salt marshes, Marshes, Halophytes, Grasses, Bacteria, Isopods, Invertebrates, Decomposing organic matter.

Scanning electron microscopy was used as a tool for observing in situ microbial organisms during the sequential degradation of *Spartina alterniflora* culms in litter bags placed in a salt marsh. Other work included an examination of the detritus producing role of *Cleantis planicauda*, an estuarine isopod, and several other macro-invertebrates associated with dead *Spartina alterniflora*. Results showed that microbial decomposition of dead *Spartina* to detritus does occur and is probably due to fungi and that macroinvertebrates, especially *Cleantis planicauda* are major degraders of dead *Spartina* to detritus. (Steiner-Mass)  
W80-00036

**REMOTE SENSING AS A TOOL FOR STUDYING THE ECOLOGY OF HALOPHYTES,**

Georgia Univ., Sapelo Island. Marine Inst.  
For primary bibliographic entry see Field 7B.  
W80-00037

**RELATIONSHIP OF VERTEBRATES TO SALT MARSH PLANTS,**

Georgia Univ., Sapelo Island. Marine Inst.  
G. F. Shanholtzer.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 463-474, 1974. 4 fig, 2 tab, 16 ref.

Descriptors: \*Salt marshes, \*Wildlife, \*Fish, \*Marsh plants, Wetlands, Marshes, Halophytes, Birds, Water birds, Nesting, Wildlife habitat, Mammals, Spatial distribution, Nutrient cycling.

Significant salt marsh plant-vertebrate relationships exist in areas subject to tidal-saline waters. Their associations assume both direct and indirect dimensions. Direct relationships involve spatial and physical utilization of the plants. Spatial utilization patterns are derived from the territory, home range, and behavior of the species using the marsh, and the structure of the plants themselves. Marsh vegeta-

tion provides a habitat volume and structural foundation for feeding, reproductive, and roosting activities. Plant cover additionally provides a moderated thermal environment and refuge from predation. Thermal considerations are important during periods of avian incubation when excessive solar radiation can damage eggs and young. Indirect relationships usually involve nutrient and material cycling in the marsh and dispersal of halophyte seeds. (Steiner-Mass)  
W80-00038

**NUTRIENT LIMITATION IN SALT MARSH VEGETATION,**

Boston Univ. Marine Program, Woods Hole, MA. Marine Biological Lab.  
I. Valiela, and J. M. Teal.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 547-563, 1974. 6 fig, 4 tab, 20 ref.

Descriptors: \*Salt marshes, \*Marsh plants, \*Plant growth, \*Fertilizers, Wetlands, Marshes, Grasses, Marsh management, Nutrients, Standing crop, Nitrogen, Ureas, Phosphates, Halophytes.

Fertilization with urea and phosphate produced significant increases in dissolved  $\text{NH}_4\text{N}$  and  $\text{PO}_4\text{P}$ , respectively, in the sediment water of treated salt marsh plots. Standing crops of marsh plants increased in the urea-fertilized plots while the standing crop in swards undergoing phosphate enrichments resembled control standing crops. This response pattern held for total aboveground vegetation and for individual standing crops of *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*. Nitrogen supply therefore is one of the most important limiting factors for salt marsh vegetation. Preliminary results suggest, however, that roots and rhizomes will not show an increase in standing crops in response to fertilization with either phosphorus or nitrogen. The urea enrichments also resulted in a general increase in nitrogen content of aboveground plant tissues, roots, and rhizomes. The increased standing crops and nitrogen contents of aboveground plant parts may be an important source of nitrogenous organic materials exported from salt marshes to nitrogen poorer estuarine waters, particularly where the salt marsh is subject to nitrogen enrichment. (Steiner-Mass)  
W80-00039

**THE POTENTIAL ECONOMIC USES OF HALOPHYTES,**

Scripts Institution of Oceanography, La Jolla, CA. Foundation for Ocean Research.  
For primary bibliographic entry see Field 6C.  
W80-00040

**CORRELATION OF APALACHICOLA RIVER FLOODPLAIN TREE COMMUNITIES WITH WATER LEVELS, ELEVATION, AND SOILS,**

Florida State Univ., Tallahassee. Dept. of Biological Science.  
H. M. Leitman.  
M.S. Thesis, August, 1978. 57 p, 7 fig, 8 tab, 30 ref, 4 append.

Descriptors: \*Floodplain, \*Trees, \*Ecological distribution, \*Florida, Swamps, Willow trees, Wetlands, Soils, Water levels, Rivers, Vegetation, Hydrogen ion concentration, Cation exchange, Elevation.

Three major floodplain tree communities were identified at two study sites on the Apalachicola River: *Taxodium distichum*-*Nyssa aquatica* in deep swamps, *Salix nigra* on point bars, and mixed bottomland hardwoods on flats and levees. Actual percent inundation was difficult to determine from river stage data because of residual water held on the floodplain and because of differences in the water holding capacity of the soils. Ground elevations within the floodplain were correlated with the various stages of the river, and this elevation-stage height correlation was a more practical indicator of community types than actual percent inundation. Soil types also correlated with major community types. (Stihler-Mass)  
W80-00041

## Field 2—WATER CYCLE

### Group 21—Water in Plants

#### NUTRITIVE VALUE OF DRIED OR ENSEILED AQUATIC PLANTS. I. CHEMICAL COMPOSITION.

Minnesota Univ., St. Paul. Dept. of Animal Science.  
J. G. Linn, E. J. Staba, R. D. Goodrich, J. C. Meiske, and D. E. Otterby.  
Journal of Animal Science, Vol. 41, No. 2, p 601-609, August, 1975. 7 tab, 15 ref.

Descriptors: \*Aquatic plants, \*Nutrients, \*Chemical analysis, Routed aquatic plants, Fibers, Feeds, Livestock, Drying, Acids, Fermentation, Calcium, Phosphorus, Proteins, Silage, Alfalfa, Corn, Hydrogen ion concentration, Ruminants.

Chemical analyses of 21 species of dried aquatic plants indicated they contain sufficient quantities of nutrients to be considered as livestock feedstuffs. Although considerable variation existed among the 21 species, 14 species contained more than 10% protein and all species contained less than 30% crude fiber. Lactic acid values and pH values were determined for fermented mixtures of ensiled aquatic plants, corn, and alfalfa. (See also W80-00299) (Bollinger-Mass)  
W80-00298

#### NUTRITIVE VALUE OF DRIED OR ENSEILED AQUATIC PLANTS. II. DIGESTIBILITY BY SHEEP.

Minnesota Univ., St. Paul. Dept. of Animal Science.  
J. G. Linn, R. D. Goodrich, D. E. Otterby, J. C. Meiske, and E. J. Staba.  
Journal of Animal Science, Vol. 41, No. 2, p 610-615, August, 1975. 5 tab, 10 ref.

Descriptors: \*Aquatic plants, \*Forage palatability, \*Sheep, \*Digestion, Routed aquatic plants, Livestock, Ruminants, Metabolism, Drying, Nutrients, Feeds, Forages, Protein, Nitrogen, Energy conversion, Hydrogen ion concentration, Acids, Fermentation.

Palatability of aquatic plants may be a limiting factor in their use as a forage for ruminants. Drying or ensiling did not appear to be satisfactory procedures for improving palatability. Digestibility in lambs of two dried aquatic plants and an ensiled mixture of aquatic plants was compared with that of alfalfa and corn on the basis of dry matter, crude proteins, energy, and nitrogen. Rumen fluid pH and acetic propionic acid ratio were also compared in lambs fed the different diets. (See also W80-00299) (Bollinger-Mass)  
W80-00299

#### PLANTS AND ANIMALS OF THE ESTUARY.

For primary bibliographic entry see Field 2L.

W80-00300

#### PLANT LIFE OF THE ESTUARY.

Connecticut Coll., New London.

For primary bibliographic entry see Field 2L.

W80-00301

#### EFFECTS OF MALATHION ON MICROORGANISMS OF AN ARTIFICIAL SALT-MARSH ENVIRONMENT.

Environmental Research Lab., Gulf Breeze, FL.  
A. W. Bourquin.  
Journal of Environmental Quality, Vol. 6, No. 4, p 373-378, October-December, 1977. 4 fig, 1 tab, 16 ref.

Descriptors: \*Salt marsh, \*Environmental effects, Artificial environment, Wetlands, Microorganisms, \*Malathion, Ecosystems, Organophosphate insecticide, \*Microbial-pesticide interaction, \*Effects of pesticides, Degradation, Microbial activities, Mirex.

Laboratory salt-marsh environments were treated with malathion, an organophosphate insecticide, and aerobic heterotrophic bacteria were monitored to determine changes in their microbial ecology. Several physiological activities were assayed in both treated and untreated controls; however, no

reliable trends in numbers of these microorganisms were detected. On the other hand, populations of malathion sole-carbon-degrading bacteria increased significantly with increasing treatment levels and in the sediments with repeated treatment. Malathion cometabolizing bacteria increased significantly over the control systems in the water column with increasing treatment levels. Although numbers of malathion-degrading bacteria increased with higher treatment levels or frequency of treatment, these changes had no effect on the total number of bacteria from the water or sediment. When an organochlorine insecticide, mirex, was used to treat the ecosystems, essentially no changes in the bacterial populations were detected. (Hinkel-Mass)  
W80-00303

#### CALORIC, ELEMENTAL, AND NUTRITIVE CHANGES IN DECOMPOSING JUNCUS ROEMERIANUS LEAVES.

Mississippi State Univ., Mississippi State. Dept. of Zoology.  
A. A. de la Cruz, and B. C. Gabriel.  
Ecology, Vol. 55, No. 4, p 882-886, Summer, 1974. 2 fig, 4 tab, 20 ref.

Descriptors: \*Decomposing organic matter, \*Marshes, Proteins, Carbon, Nitrogen, Energy, Routed aquatic plants, Wetlands.

In situ decomposition rate of *Juncus roemerianus* (Juncaceae) leaves determined by litterbag method was 40% per year. Caloric, elemental, and proximate nutritive analyses of leaves at various stages of life and decay—classified as young, mature, standing dead, partially decayed, decomposed fragments, and particulate detritus—showed the following: (a) an increase in caloric content (4630-4911 g cal/ash-free g); (b) a decrease in carbon (49.75%-6.3%), nitrogen (1.09%-0.57%), and phosphorus (0.22%-0.17%); and (c) a decrease in crude fiber (37%-9%), carbohydrate (52%-11%), protein (9%-4%) and fats (2.0%-0.82%). Particulate detritus retrieved from litterbags decomposed in incubation flasks at the rate of 50% in 36 days. At intervals of 0, 5, 13, 25, and 36 days, analyses of detritus showed the following: (a) a decrease in organic content (67%-32%) and carbon (5.6%-3.2%); and (b) an increase in nitrogen (0.44%-1.21%) and respiration rates (0.11%-1.10 mg O<sub>2</sub> hr<sup>-1</sup> ash-free g<sup>-1</sup>). The increase in nitrogen of detritus and consequently protein is attributed to conversion of plant tissue to microbial protoplasm as evidenced by increased respiration rates. (Stihler-Mass)  
W80-00307

#### FACTORS INFLUENCING SHOOT PRODUCTION AND MINERAL NUTRIENT LEVELS IN TYPHA LATIFOLIA.

Savannah River Ecology Lab., Aiken, SC.  
C. E. Boyd, and L. W. Hess.  
Ecology, Vol. 51, No. 2, p 296-300, Early Spring, 1970. 3 fig, 3 tab, 22 ref.

Descriptors: \*Standing crop productivity, \*Nutrients, \*Swamps, Floodplain, Aquatic plants, Phosphorus, *Typha latifolia*.

Shoot standing crops for *Typha latifolia* ranged from 428 to 2,252 g dry wt/m<sup>2</sup>. Standing crops were positively correlated with concentrations of dilute acid soluble phosphorus in hydrosols and dissolved phosphorus in the waters. Except for a weak correlation for dissolved calcium, additional site fertility parameters were not correlated with standing crop. Tissue nutrient levels varied considerably, maximum values for most minerals being three or four times as great as the smallest values. Correlations between environmental levels of several nutrients and tissue concentrations were significant, but not very strong. Tissue concentrations of most nutrients were positively correlated with nitrogen content. Despite variations in tissue levels of nutrients, standing crop was the decisive factor determining quantities of nutrients per unit area of stand. (Hinkel-Mass)  
W80-00308

#### SAMPLING MACRO-ORGANIC MATTER PROFILES IN SALT MARSH PLANT ROOT ZONES.

Georgia Univ., Sapelo Island. Marine Inst.  
J. L. Gallagher.  
Proceedings of the Soil Science Society of America, Vol. 38, p 154-155, 1974. 1 fig, 1 tab, 3 ref.

Descriptors: \*Salt marsh, \*Root zones, \*Wetland soils, \*Marsh plants, Salt marsh plant, Organic matter, Soil cover, Underground aerial biomass ratios, *Spartina*, *Distichlis*, *Juncus*.

A device for sampling the root zones of marsh plants and a method for processing the resulting cores are described. Using these techniques, five stands of marsh plants were sampled and their macro-organic matter profiles compared. The least total macro-organic matter was found in the high vigor *Spartina alterniflora* Loisel. and the *Distichlis spicata* (L.) Greene root zones. Within *S. alterniflora* stands, the macro-organic matter in the soil profile increased as vigor of the aerial portions decreased. *Juncus roemerianus* Scheele and short form *S. alterniflora* profiles were similar in shape and had the highest macro-organic matter content. (Hinkel-Mass)  
W80-00309

#### VEGETATION CHANGES IN A SHALLOW AFRICAN LAKE: RESPONSE OF THE VEGETATION TO A RECENT DRY PERIOD.

Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.  
For primary bibliographic entry see Field 2H.

W80-00313

#### RESISTANCE OF THE MICROBIAL COMMUNITY WITHIN SALT MARSH SOILS TO SELECTED PERTURBATIONS.

Georgia Univ., Athens. Dept. of Microbiology.  
R. R. Christian, K. Bancroft, and W. J. Wiebe.  
Ecology, Vol. 59, No. 6, p 1200-1210, Autumn, 1978. 3 fig, 6 tab, 49 ref.

Descriptors: \*Salt marshes, \*Microorganisms, \*Resistance, Aquatic plants, Marsh, Wetlands, Ecology, Aquatic habitats, Nutrients, Georgia, *Spartina*, *Spartina alterniflora*, Ecosystems, Ecological distribution.

The response of the soil microbial community to selected long-term perturbations was examined in a *Spartina alterniflora* salt marsh on Sapelo Island, Georgia. In two perturbation experiments, macrophytic primary production was removed from marsh plots by clipping shoots and pruning beneath ground parts for periods up to 18 months. In a third experiment, monthly enrichments of glucose, ammonium nitrate and their combination were made for five months to both clipped and pruned plots as well as unclipped control plots. The state of the microbial community was monitored by adenosine triphosphate and total adenylate concentrations, community adenylate energy charge ratio and aerobic uptake of C14-glucose by mud slurries. Overall responses were consistent with the hypothesis that the soil microbial community is relatively unlinked to plant growth. This 'unlinking' appears responsible for the observed resistance to change by the microbial community in the face of perturbations to the marsh system. The hypothesis that the microbial community is limited by physiochemical and spatial factors rather than nutrient availability is supported. (Howard-Mass)  
W80-00314

#### EFFECTS OF A DRAWDOWN ON A WATER-FOWL IMPOUNDMENT.

Michigan Dept. of Conservation, Lansing. Rose Lake Wildlife Experiment Station.  
For primary bibliographic entry see Field 2H.

W80-00315

#### MANGROVES: A REVIEW.

Environmental Research Lab., Gulf Breeze, FL; and Corvallis Environmental Research Lab., OR. Associate Lab.



## Field 2—WATER CYCLE

### Group 2J—Erosion and Sedimentation

Curves show particle-size distribution of suspended sediment collected by different sampling methods in the Amazon River during high-water seasons of 1976 and 1977. Samples were collected between the mouth of the Amazon River and Iquitos, about 3,700 km upstream from the mouth. Sampling equipment included Niskin bottles, a point sampler, a depth-integrating sampler, and a bucket. Sediment concentrations of fine sediments from near-surface samples were about 50 percent of the concentrations from depth-integrated samples. (Woodward-USGS) W80-00220

#### SEDIMENT YIELD EQUATION FROM AN EROSION SIMULATION MODEL, Science and Education Administration, Tucson, AZ. Southwest Rangeland Water Research Center.

E. D. Shirley, and L. J. Lane. In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 90-96, 2 fig, 8 ref.

Descriptors: \*Sedimentation rates, \*Sediment yield, \*Water pollution sources, \*Estimating equation, \*Equations, \*Overland flow, \*Simulation analysis, Model studies, Sedimentation, Erosion, Numerical analysis, Rill erosion, Runoff, Hydraulic properties, Watershed management, Land use, Forecasting.

It is important to assess the impact of various land use and management practices upon sediment yield, a significant water pollutant, from upland areas. Accordingly, a simplified sediment yield equation is derived here from partial differential equations for overland flow with rill and interrill erosion on a plane to facilitate the prediction of erosion and sediment yield as functions of runoff, soil and watershed characteristics. The equation which incorporates hydraulic resistance, rill and interrill erodibility terms, distance (watershed area) and runoff volume was used to compute sediment yields for a number of events on a small semiarid watershed. Computed sediment yields compared favorably with observations and with estimates made with the Universal Soil Loss Equation (USLE), although the derived sediment yield equation accounts for decreasing sediment yield with increasing watershed area. It is concluded, based upon this analysis of the sediment yield equation and its properties that it produces reasonable estimates for sediment yields in small semiarid watersheds. (Tickes-Arizona) W80-00280

#### GEOMORPHIC FEATURES AFFECTING TRANSMISSION LOSS POTENTIAL ON SEMIARID WATERSHEDS, Science and Education Administration, AZ. Southwest Watershed Research Center.

D. E. Wallace, and L. J. Lane. In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 157-164, 8 fig, 9 ref.

Descriptors: \*Geomorphology, \*Water loss, \*Ephemeral streams, \*Stream erosion, Semiarid climates, Equations, Channel erosion, Gravels, Alluvium, Sediment load, Sediment yield, Stream gages, Data collections, Drainage area, Stream stabilization, Watersheds(Basins), Arizona.

An attempt is made to devise a workable method of estimating the volumes of channel fill or stream gravel in ephemeral drainage networks in south-eastern Arizona based upon the concept that the analysis of stream order and drainage area versus alluvium volume allow preliminary estimates of transmission loss potential to be made for ungauged areas. Data collected at the Santa Rita Experimental Range 30 miles south of Tucson and at the Walnut Gulch Experimental Watershed near Tombstone, Arizona, indicated watershed area to

be the dominant variable. As compared with the effect of the watershed area, stream order did not exert any great influence on the equations derived, although the credibility of using drainage area alone in the predictive equation has been enhanced by the analysis of relations existing between width and depth of ephemeral channels versus stream order and those existing between drainage network versus watershed area. It is concluded that the method elucidated is sufficiently accurate to use as a tool for estimating transmission loss potential in preliminary site evaluation and land resource surveys. (Tickes-Arizona) W80-00289

#### ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS (1968) AND SEDIMENT CORES (1976) FROM LAKE ONTARIO, Ontario Ministry of Agriculture and Food, Guelph. Pesticide Residue Lab. For primary bibliographic entry see Field 5A. W80-00341

INFLUENCE OF NEARSHORE TILL LITHOLOGY ON LATERAL VARIATIONS IN COASTLINE RECESSION RATE ALONG SOUTHEASTERN LAKE MICHIGAN, Michigan Univ., Ann Arbor. Dept. of Civil Engineering. D. H. Gray, and B. H. Wilkinson. Journal of Great Lakes Research, Vol. 5, No. 1, p 78-83, 1979, 5 fig, 2 tab, 18 ref.

Descriptors: \*Lake Michigan, \*Shores, \*Beach erosion, Lakes, Coasts, Petrology, Geology, Soils, Rocks, Till, Glacial drift, Waves(Water), Water levels, Geomorphology, Erosion rates, Erosion, Bluffs, Bluff recession rates.

Retreat of coastal bluffs around margins of the Great Lakes is a continuing process. Despite the positive correlation which exists between lake level and recession rates, considerable lateral variation in rates is typical of many coastal areas, while causes of this spatial variation are not well understood. Detailed examination of a 10 km segment of Lake Michigan shore near the town of Glenn, Michigan, suggested that lateral variations in the lithology of Pleistocene drift are directly correlative with spatial variations in recession rates. High recession rates and concave shorelines occur along segments composed of either outwash sand or sandy till which contains gravel up to 2 cm in diameter as the coarsest clast size. Conversely, low rates and the occurrence of convex shoreline segments are related to exposures of bouldery till. The exact nature of the relationship between bouldery till and the low recession rates is ambiguous. Features observed along this area suggest two non-mutually exclusive possibilities: (1) during erosion, bouldery till develops flat gently sloping wave-cut benches in the upper shoreface; and (2) erosion of this coarse till results in the development of upper shoreface surfaces covered with large boulders. Both features may serve to attenuate wave energy in the nearshore zone. In either case, lateral variation in the recession rates near Glenn is greatly influenced by the lithology of glacial drift exposed in bluff faces and the nearshore areas. (Sims-ISWS) W80-00348

### 2K. Chemical Processes

#### RATE OF LOSS OF AMMONIA FROM WATER TO THE ATMOSPHERE, Canada Centre for Inland Waters, Burlington (Ontario) and National Water Research Inst., Burlington (Ontario).

R. R. Weiler. Journal of the Fisheries Research Board of Canada, Vol. 36, No. 6, p 685-689, June 1979, 3 fig, 1 tab, 13 ref.

Descriptors: \*Ammonia, \*Boundary processes, \*Air-water interfaces, \*Laboratory tests, Atmosphere, Water quality, Testing procedures, On-site investigations, Foreign research, Wind velocity, Hydrogen ion concentration, Analysis, Analytical techniques, \*Exchange coefficients, Ammonia loss.

The rate of loss of ammonia from water to the atmosphere was measured both in the field and in the laboratory as a function of wind speed, temperature, and pH. The exchange coefficient,  $K_{sub 6}$ , was found to be a linear function of wind speed and temperature. Although the loss rates (1-10 kg/ha/d) are quite high at pH 9 and at ammonia concentrations greater than 1 mg N/cu dm, the rates are much smaller under the conditions found in most natural water bodies. (Humphreys-ISWS) W80-00075

#### DIAGENESIS OF ORGANIC MATTER IN THE SEDIMENTS OF LAKES ONTARIO, ERIE, AND HURON, Canada Centre for Inland Waters, Burlington (Ontario).

A. L. W. Kemp, and L. M. Johnston. Journal of Great Lakes Research, Vol. 5, No. 1, p 1-10, 1979, 3 fig, 5 tab, 21 ref.

Descriptors: \*Great Lakes, \*Sediments, \*Organic matter, \*Lake Ontario, \*Lake Erie, \*Lake Huron, Chemicals, Chemical reactions, Diagenesis, Amino acids, Carbohydrates, Lipids, Sampling, Cores, Chemical analysis, Lakes, Lake sediments, Bottom sediments, Sedimentation, Sedimentology, Limnology.

The organic matter in the modern sediments of Lakes Ontario, Erie, and Huron is composed of humic compounds (68 to 83%), amino acids (19 to 20%), lipids (2 to 8%), carbohydrates (2 to 6%), and amino sugars (0.5 to 4%). Amino acid and carbohydrate concentrations are high in plankton samples, which are the primary source of the sedimentary organic matter. These compounds are decomposed during their passage through the food chains and while resting at the sediment-water interface with the concurrent formation of humic compounds. The degree of diagenesis of the modern sedimentary organic matter is related to both the trophic state of the lake and to the water depth, with the greatest amount in the most eutrophic lake basins and in the shallowest water depths. Diagenesis of the organic matter is rapid prior to burial in the sediments and is slow after burial. The decomposition rates of the sedimentary organic matter are in the following order: amino acids much greater than amino sugars greater than carbohydrates greater than humic compounds greater than lipids. (Sims-ISWS) W80-00088

#### TRICHLOROFLUOROMETHANE IN GROUNDWATER--A POSSIBLE TRACER AND INDICATOR OF GROUNDWATER AGE, Indiana Univ. at Bloomington. Dept. of Geology. For primary bibliographic entry see Field 2F. W80-00096

#### PRECIPITATION AND STREAMWATER CHEMISTRY IN AN UNDISTURBED FORESTED WATERSHED IN NEW HAMPSHIRE, Northeastern Forest Experiment Station, Durham, NH.

C. W. Martin. Ecology, Vol. 60, No. 1, p 36-42, Feb 1979, 4 fig, 4 tab, 24 ref.

Descriptors: \*Cycling nutrients, \*Forest watersheds, \*Nitrogen, Chemistry of precipitation, Hydrology, Ion transport, Nutrients, Streamflow, Watershed(Basins), Biogeochemistry, \*Forest hydrology, Chemistry of streams, Forest succession, New Hampshire, Undisturbed forest.

Precipitation and streamwater from the Bowl, a watershed in central New Hampshire, were analyzed chemically during 1973 and 1974. The Bowl, covered by northern hardwood forest with spruce and fir at higher elevations, has never been logged or disturbed by humans. The biogeochemistry of the cations seemed to be regulated more by precipitation, soil-water movement, and chemical weathering reactions than by forest succession. Nitrate concentrations remained nearly constant in the streamwater throughout the study, with no apparent seasonal fluctuations; in contrast, nitrate concentrations in the stream draining a nearby 55-

yr-old forest definitely declined during the growing season. Nitrate budgets indicated a net loss of this important plant nutrient from both watersheds. A net accumulation of ammonium was sufficient to give a net increase of total nitrogen in both watersheds. These data do not support the hypothesis of Vitousek and Reiners that old-growth forests may reach a point of no net growth and no net uptake of nutrients. Mixed deciduous-coniferous forests in New England, free from human disturbances, may reach an age where they become prone to natural disturbances that create a mosaic of similar-aged groups of trees, each group having differing abilities to accumulate nutrients. (Forest Service) W80-00201

**GROUND-WATER DATA IN THE BAKER COUNTY-NORTHERN MALHEUR COUNTY AREA, OREGON,**  
Geological Survey, Portland, OR. Water Resources Div.  
For primary bibliographic entry see Field 2F. W80-00226

**GROUND-WATER RESOURCES OF WASHINGTON PARISH, LOUISIANA,**  
Geological Survey, Baton Rouge, LA. Water Resources Div.  
For primary bibliographic entry see Field 2F. W80-00227

**APPLICATION OF GEOCHEMICAL KINETIC DATA TO GROUND-WATER SYSTEMS: A TUFFACEOUS-ROCK SYSTEM IN SOUTHERN NEVADA,**  
Geological Survey, Denver, CO. Water Resources Div.  
H. C. Claassen, and A. F. White.  
In: Chemical Modeling in Aqueous Systems: American Chemical Society Symposium Series, No. 93, p 771-793, September 1978. 8 fig, 4 tab, 11 ref.

Descriptors: \*Aquifer characteristics, \*Chemical properties, \*Kinetics, \*Sorption, \*Water quality, Model studies, Diffusion, Geochemistry, Waste assimilative capacity, Montmorillonite, Nevada, \*Rainier Mesa, Water quality simulation.

Kinetic modeling was used to estimate the effective surface area of aquifer in contact with a unit volume of ground water for a composite saturated-unsaturated ground-water system in southern Nevada. This aquifer property, not obtainable by other means, is necessary for realistic modeling of solute transport in ground-water systems. The results of the kinetic modeling indicate that only a small part of the total interconnected pore space is available for transport of water to the water table. The aquifer studied is composed of both vitric (glassy) and devitrified (crystalline) volcanic tuff of nearly identical chemical composition. Comparison of laboratory and field data indicated that only the vitric phase has a significant influence on ground-water composition. Laboratory determination of mass-transfer rates from the vitric material to solution as functions of pH allowed simulation of the natural water's cation composition. Simulated results were improved considerably when the model was modified to take into account precipitation of the clay mineral, montmorillonite. Estimates of surface area per unit volume obtained from the kinetic model are 0.3 to 3 percent of those obtained independently from Braunauer-Emmett-Teller surface area measurements. (Woodward-UGS) W80-00232

**PYRITE: ITS RAPID FORMATION IN A SALT MARSH AND ITS IMPORTANCE TO ECOSYSTEM METABOLISM,**  
Woods Hole Oceanographic Institution, MA. Joint Program in Biological Oceanography.  
R. W. Howarth.  
Science, Vol. 203, No. 4375, p 49-51, 5 January 1979. 2 tab, 14 ref.

Descriptors: \*Pyrite, \*Salt marshes, \*Ecology, Sulfur, Sulfur compounds, Metabolism, Wetlands, Marshes, Respiration, Peats, Ecosystems.

Pyrite formation in salt-marsh peat occurs more rapidly than is generally thought for any natural system. Pyrite is the major end product of sulfate reduction, and sulfate reduction is the major form of respiration in the salt-marsh ecosystem. When the rapid formation of pyrite is ignored, the rates of sulfate reduction and ecosystem respiration may be grossly underestimated. (Stihler-Mass) W80-00311

**RESISTANCE OF THE MICROBIAL COMMUNITY WITHIN SALT MARSH SOILS TO SELECTED PERTURBATIONS,**  
Georgia Univ., Athens. Dept. of Microbiology.  
For primary bibliographic entry see Field 2I. W80-00314

**NITROGEN DYNAMICS AND MODELING IN A FRESHWATER WETLAND,**  
Michigan Univ., Ann Arbor.  
M. F. Bender.  
Ph.D. Dissertation, 1976. 108 p.

Descriptors: \*Freshwater marshes, \*Nitrogen, \*Model studies, Wetlands, Marshes, Bogs, Peat, Nitrogen cycle, Nitrates, Nitrites, Ammonia, Marsh plants, Mathematical models, Root zone, Distribution patterns.

The concentrations of the oxidized forms of nitrogen, nitrate and nitrite exhibit seasonal variations and variations caused by vegetative cover type. Nitrogen concentrations drop in late spring-early summer because of absorption by emergent vegetation. During the growing season, nitrite concentrations increase in the root zone and then decrease until late fall when near concentrations in the root zone and below the root zone are nearly the same. The magnitude of the difference in mean concentration for both nitrate-nitrite, and ammonium between the surface and the root zone varies with the vegetative cover type. Generally, leatherleaf-bog birch areas showed a greater difference than the other areas examined. Ammonium concentrations in the peatland-marsh are dependent upon the vegetative cover type, the season, and the depth. Two types of nitrogen models were derived: (1) a set of six empirical algebraic equations for predicting nitrate-nitrite, and ammonium concentrations for the three dominant vegetative cover types in the peatland-marsh, (2) a compartmental model with nitrogen in the five forms: nitrate, ammonium, nitrogen in living organic form, nitrogen in dead organic form, and nitrogen in gaseous forms expressed as time varying differential equations in the five primary components in the wetland. (Steiner-Mass) W80-00327

## 2L. Estuaries

**WATER RELATIONS OF THREE MANGROVE SPECIES IN SOUTH FLORIDA,**  
San Diego State Univ., CA. Dept. of Biology.  
For primary bibliographic entry see Field 2I. W80-00009

**COMPARATIVE ECOLOGICAL REQUIREMENTS OF A PERENNIAL AND AN ANNUAL SALICORNIA SPECIES: GERMINATION AND GROWTH DURING THE EARLY STAGES OF DEVELOPMENT, (IN FRENCH),**  
Centre National de la Recherche Scientifique, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques Louis-Emberger.  
For primary bibliographic entry see Field 2I. W80-00010

**SURFICIAL SEDIMENTS OF SALDANHA BAY AND LANGEBAAN LAGOON,**  
Cape Town Univ. (South Africa). Dept. of Geology.  
For primary bibliographic entry see Field 2J. W80-00012

**GROWTH AND SALT ACCUMULATION IN TWO ANNUAL SPECIES OF SALICORNIA**

**FROM THE MEDITERRANEAN COAST, (IN FRENCH),**  
Centre National de la Recherche Scientifique, Montpellier (France). Dept. de Physiologie Ecologique.  
For primary bibliographic entry see Field 2I. W80-00018

**THE INFLUENCE OF SALINITY, INUNDATION AND TEMPERATURE ON THE GERMINATION OF SOME HALOPHYTES AND NON-HALOPHYTES,**  
Vrije Univ., Amsterdam (Netherlands). Biological Lab.  
For primary bibliographic entry see Field 2I. W80-00022

**BEACH AND SALT MARSH VEGETATION OF THE NORTH AMERICAN PACIFIC COAST,**  
California Univ., Santa Barbara. Dept. of Geological Sciences.  
For primary bibliographic entry see Field 2I. W80-00031

**A REVIEW OF STRUCTURE IN SEVERAL NORTH CAROLINA SALT MARSH PLANTS,**  
North Carolina State Univ. at Raleigh. Dept. of Botany.  
For primary bibliographic entry see Field 2I. W80-00032

**SALT TOLERANCE OF MANGROVES AND SUBMERGED AQUATIC PLANTS,**  
Texas Univ. at Austin. Plant Ecology Research Lab.  
For primary bibliographic entry see Field 2I. W80-00033

**MATHEMATICAL MODELING—SPARTINA,**  
Georgia Univ., Sapelo Island. Marine Inst.  
For primary bibliographic entry see Field 2I. W80-00034

**THE ROLE OF OVERWASH AND INLET DYNAMICS IN THE FORMATION OF SALT MARSHES ON NORTH CAROLINA BARRIER ISLANDS,**  
Massachusetts Univ., Amherst. Dept. of Botany.  
P. J. Godfrey, and M. M. Godfrey.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 407-427, 1974. 12 fig, 11 ref.

Descriptors: \*Salt marshes, \*Geomorphology, \*Overland flow, Wetlands, Marshes, North Carolina, Islands, Inlets (Waterways), Storm runoff, Soil dynamics, Land forming.

Analysis of time sequence aerial photographs and field studies at Codd's Creek, Cedar Inlet, and Drum Inlet suggest that the present pattern of salt marshes behind the Outer Banks is the result of overwash deposition and inlet dynamics. Oceanic overwash provides sand from the beach during every severe storm, while inlet closure forms new marshes at much longer intervals. Once the inlet is closed, however, marsh formation proceeds rapidly. Both processes are of prime importance and complement each other; submergence of uplands by rising sea level also leads to new salt marshes, but this is a more important process on the mainland than on the Outer Banks. (Steiner-Mass) W80-00035

**PROBABLE AGENTS FOR THE FORMATION OF DETRITUS FROM THE HALOPHYTE, SPARTINA ALTERNIFLORA,**  
Brunswick Junior Coll., GA.  
For primary bibliographic entry see Field 2I. W80-00036

**REMOTE SENSING AS A TOOL FOR STUDYING THE ECOLOGY OF HALOPHYTES,**  
Georgia Univ., Sapelo Island. Marine Inst.  
For primary bibliographic entry see Field 7B.

## Field 2—WATER CYCLE

### Group 2L—Estuaries

W80-00037

**RELATIONSHIP OF VERTEBRATES TO SALT MARSH PLANTS,**  
Georgia Univ., Sapelo Island. Marine Inst.  
For primary bibliographic entry see Field 2I.  
W80-00038

**NUTRIENT LIMITATION IN SALT MARSH VEGETATION,**  
Boston Univ. Marine Program, Woods Hole, MA.  
Marine Biological Lab.  
For primary bibliographic entry see Field 2I.  
W80-00039

**THE POTENTIAL ECONOMIC USES OF HALOPHYTES,**  
Scripts Institution of Oceanography, La Jolla, CA.  
Foundation for Ocean Research.  
For primary bibliographic entry see Field 6C.  
W80-00040

**WINTER CIRCULATION IN THE WESTERN GULF OF MAINE: PART 2. CURRENT AND PRESSURE OBSERVATIONS,**  
Woods Hole Oceanographic Institution, MA.  
J. A. Vermersch, R. C. Beardsley, and W. S. Brown.  
Journal of Physical Oceanography, Vol. 9, No. 4, p 768-784, July 1979. 20 fig, 3 tab, 25 ref, 1 append.  
NSF DES74-03001, OCE76-01813.

Descriptors: \*Ocean circulation, \*Winter, \*Coasts, \*Maine, Continental shelf, Currents(Water), Ocean currents, Circulation, Water circulation, Winds, Pressure, Tides, Sampling, On-site investigations, Instrumentation, Equipment, Data processing, Oceanography, \*Gulf of Maine.

The wintertime circulation in the western Gulf of Maine was studied with moored current, temperature, and pressure array, which was deployed from November 1974 to January 1975. These observations were interpreted with three additional data sets: coastal sea level records, Portland Lightship meteorological data, and offshore hydrographic transect data which describe the evolution of the density field on weekly time scales. The observed mean currents were consistent with the idea of a cyclonic Gulf of Maine gyre. The subtidal current fluctuations were coherent in the vertical at each mooring but were incoherent between the moorings, which were separated by about 50 km in both the alongshore and offshore direction. Furthermore, the currents showed only weak coherence with the winds. The pressure field was highly coherent over the whole Gulf of Maine. Therefore, estimates of the pressure gradient vector inside and outside the 100 m isobath were made using coastal subsurface and bottom pressure records. The alongshore pressure gradient for the deeper water was found to be quite coherent with the winds for periods between 35 and 200 h. The relation of the pressure gradients and the winds in the shallower water suggests the development of a transient coastal boundary layer. (See also W78-08579) (Sims-ISWS)  
W80-00069

**TRITIUM AND OXYGEN PROFILES IN THE EASTERN MEDITERRANEAN,**  
Laboratorio di Geologia Nucleare, Pisa (Italy).  
For primary bibliographic entry see Field 5B.  
W80-00078

**ON THE GREEN'S FUNCTION OF LAPLACE'S TIDAL EQUATION, AN APPLICATION TO THE NORTHERN ADRIATIC SEA,**  
Rome Univ. (Italy). Ist. di Fisica.  
E. Paschini, and E. Salusti.  
Tellus, Vol. 31, No. 2, p 145-149, April 1979. 2 fig, 1 tab, 9 ref.

Descriptors: \*Tides, \*Water levels, \*Mathematical models, Laplace's equation, Model studies, Analytical techniques, Theoretical analysis, On-site tests, Sea level, Equations, Analysis, Foreign research,

\*Adriatic Sea, \*Venice(Italy), \*Italy, Greens function.

To evaluate the effect of external forces on the northern water motion of Adriatic Sea, Green's Function of Laplace's tidal equation was calculated for a simple geometry. As an application, known data on sea level variations at various stations were used, in order to determine the external forces. The 'theoretical' sea level at Venice was computed. Its comparison with 'experimental' data taken at Venice gave encouraging results. The numerical results showed a remarkable agreement between theoretical and experimental data. (Humphreys-ISWS)  
W80-00079

**A DYNAMIC THERMODYNAMIC SEA ICE MODEL,**  
Army Terrestrial Sciences Center, Hanover, NH.  
For primary bibliographic entry see Field 2C.  
W80-00084

**TEMPORAL RATES OF GROWTH AND DECAY OF MICROSCOPIC AND MACROSCOPIC SURFACE STRUCTURES IN A WIND-WAVE TANK,**  
Delaware Univ., Newark. Coll. of Marine Studies.  
J. Wu.  
Journal of Physical Oceanography, Vol. 9, No. 4, p 802-814, July 1979. 9 fig, 21 ref, 1 append. ONR N00014-75-C-0285.

Descriptors: \*Waves(Water), \*Growth rates, \*Winds, \*Laboratory tests, Friction, Fluid friction, Remote sensing, Radar, Data processing, Statistics, Oceanography, Wave decay.

The distributions of wave surface slopes and wave heights were measured under suddenly started and stopped winds. The root-mean-square slopes and average wave heights were found to grow and decay exponentially with time; in each case, the growth rate was faster than the decay rate. Quantitative growth and decay rates of these slopes and heights approaching and departing an equilibrium state, respectively, were presented. The growth rates show strong dependence, and the decay rates show insignificant dependence on wind-friction velocity. The growth time of slope statistics was found to be shorter than that of height statistics, suggesting that the ripples can be excited directly and effectively by the wind and that wave-wave interaction and wind gusts are important to wave generation by wind. This comparison, along with measurements of instantaneous growth of microscopic surface structures reported by others, also revealed that the development of the wave spectrum indeed starts at the high-frequency end, and that for remote sensing of sea-surface wind an uncertainty is introduced by unsteadiness of the wind. (Sims-ISWS)  
W80-00085

**ROLE OF DYNAMIC COASTAL PROCESSES IN THE IMPACT AND DISPERSAL OF THE AMOCO CADIZ OIL SPILL (MARCH 1978)**  
BRITTANY, FRANCE.  
South Carolina Univ., Columbia. Dept. of Geology.  
For primary bibliographic entry see Field 5C.  
W80-00154

**PLANTS AND ANIMALS OF THE ESTUARY,**  
Connecticut Arboretum Bull. No. 23, June, 1978. 44 p, 13 ref. Olmstead, N. C. (ed.), Connecticut College, New London.

Descriptors: \*Estuaries, \*Invertebrates, \*Fish, \*Algae, Connecticut, Animals, Aquatic plants, Coastal areas, Seashores, Wetlands.

This non-technical guide describes and illustrates the typical animals (invertebrates and fishes) and seaweeds of the shallow nearshore Connecticut waters. (See W80-00301 and W80-00302) (Stihler-Mass)  
W80-00300

**PLANT LIFE OF THE ESTUARY,**  
Connecticut Coll., New London.  
S. L. Taylor, and M. Willard-Bohusack.  
In: Plants and Animals of the Estuary, Connecticut Arboretum Bull. No. 23, p 4-12, 1978.

Descriptors: \*Estuaries, \*Algae, \*Coastal areas, \*Connecticut, Aquatic plants, Phaeophyta, Chlorophyta, Rhodophyta, Wetlands.

Green, brown, and red algae typical of shallow nearshore Connecticut water are described and illustrated. Eelgrass is also discussed. (See also W80-00300) (Stihler-Mass)  
W80-00301

**ESTUARINE ANIMALS,**  
Connecticut Coll., New London.  
N. C. Olmstead, and P. E. Fell.  
In: Plants and Animals of the Estuary, Connecticut Arboretum Bull. No. 23, p 12-44, 1978.

Descriptors: \*Estuaries, \*Animals, \*Invertebrates, \*Fish, Connecticut, Coastal areas, Seashores, Wetlands.

This non-technical guide describes and illustrates the typical animals (sponges, cnidarians, comb jellies, segmented worms, molluscs, arthropods, bryozoans, echinoderms, and chordates) of shallow nearshore Connecticut waters. (See also W80-00300) (Stihler-Mass)  
W80-00302

**FISHERY SURVEY OF CEDAR LAKES AND THE BRAZOS AND SAN BERNARD RIVER ESTUARIES,**  
Texas Parks and Wildlife Dept., Austin.  
For primary bibliographic entry see Field 2H.  
W80-00305

**MANGROVES: A REVIEW,**  
Environmental Research Lab., Gulf Breeze, FL; and Corvallis Environmental Research Lab., OR.  
Associate Lab.  
For primary bibliographic entry see Field 2I.  
W80-00319

**MARSH SOILS OF THE ATLANTIC COAST,**  
Delaware Univ., Newark. Dept. of Plant Science.  
For primary bibliographic entry see Field 2G.  
W80-00320

**THE RELATIONSHIP OF MARINE MACROINVERTEBRATES TO SALT MARSH PLANTS,**  
Georgia Univ., Sapelo Island. Marine Inst.  
For primary bibliographic entry see Field 2I.  
W80-00321

**BUBBLE POPULATIONS AND SPECTRA IN COASTAL WATERS: A PHOTOGRAPHIC APPROACH,**  
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Oceanography.  
B. D. Johnson, and R. C. Cooke.  
Journal of Geophysical Research, Vol. 84, No. C7, p 3761-3766, July 20, 1979. 10 fig, 14 ref.

Descriptors: \*Bubbles, \*Coasts, \*Waves(Water), \*Turbulence, Ocean waves, Winds, Photography, On-site investigations, Sampling, Measurement, Equipment, Instrumentation, Oceanography.

A photographic analysis of bubbles generated in coastal seas by breaking waves and general turbulence has allowed the number and spectrum of sizes of bubbles greater than 17 micrometers in radius to be counted and observed. A distribution of numbers and sizes was presented for bubbles at 1.5-m depth arising from wave activity driven by winds of from 8 to 10 m/s; under these conditions, the number of bubbles was 27,000/cu m. In winds of 11-13 m/s, the numbers of bubbles determined from photographs were 480,000/cu m at 0.7-m depth, 160,000/cu m at 1.8-m depth, and 16,000/cu m at 4-m depth. The data acquired by this tech-

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Domestic and Municipal Use—Group 3D

nique enabled the authors and others to calculate the rate of the invasion of atmospheric gas into and out of the sea and to investigate the production of nonliving organic particulate matter by the processes of adsorption and bubble dissolution. The numbers of bubbles that do not dissolve completely but rise to the sea surface and burst were also calculable and are fundamental to quantifying the production of marine aerosols. A comparison of this technique with classical acoustic methods is now imperative. (Sims-ISWS)  
W80-00352

#### DENITRIFICATION IN A SALT MARSH ECOSYSTEM

Marine Biological Lab., Woods Hole, MA. Boston Univ. Marine Program.  
W. Kaplan, I. Valiela, and J. M. Teal.  
*Limnology and Oceanography*, Vol. 24, No. 4, p. 726-734, July 1979. 5 fig, 1 tab, 30 ref. NSF GA-41506, GA-43008, GA-43009.

Descriptors: \*Denitrification, \*Salt marshes, \*Massachusetts, Nitrates, Nitrites, Nitrogen compounds, Nutrients, Wetlands, Marshes, Coastal marshes, Tidal marshes, Marsh plants, Vegetation, Temperature, Nitrification, Nitrogen fixing, Nitrogen cycle, Aquatic bacteria, Groundwater, Sampling, On-site investigations, \*Great Sippewissett Marsh(MA).

The rate of denitrification measured throughout the year in various habitats of a New England salt marsh was correlated to temperature and was highest in the wettest habitats. Over 60% of the denitrification took place in the muddy creek bottoms. Annual denitrification exceeds nitrogen fixation. An amount of nitrate similar to the quantity consumed by denitrifiers is supplied by the flow of groundwater into the marsh and by nitrifiers within the marsh itself. (Sims-ISWS)  
W80-00355

#### LAGRANGIAN AND EULERIAN MEASUREMENTS OF HORIZONTAL MIXING IN THE BALTIC

Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.  
For primary bibliographic entry see Field 5B.  
W80-00359

#### FRESHWATER AND THE FLORIDA COAST: SOUTHWEST FLORIDA

For primary bibliographic entry see Field 6E.  
W80-00367

### 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

#### 3B. Water Yield Improvement

#### WATER CONSERVATION AND ALTERNATIVE WATER SUPPLIES, PROCEEDINGS OF A SOUTHEAST REGIONAL CONFERENCE NOVEMBER 8-9, 1978 AT THE GEORGIA INSTITUTE OF TECHNOLOGY

For primary bibliographic entry see Field 6D.  
W80-00001

#### MODELING MANAGEMENT OF PONDEROSA PINE FOREST RESOURCES, ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FLAGSTAFF, AZ.

For primary bibliographic entry see Field 2A.  
W80-00228

#### ACTION PROGRAMS FOR WATER YIELD IMPROVEMENT ON ARIZONA'S WATERSHEDS: POLITICAL CONSTRAINTS TO IMPLEMENTATION

Arizona Univ., Tucson. School of Renewable Natural Resources; and Wisconsin Univ.-Madison. Dept. of Forestry.  
H. J. Cortner, and M. P. Berry.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az., p 45-52, 8 ref.

Descriptors: \*Project post-evaluation, \*Water yield improvement, \*Administrative agencies, \*Political constraints, \*Watershed management, Surface waters, Comprehensive planning, Economic efficiency, Decision making, Project planning, Arizona Water Resources Committee, Arizona Watershed Program, Evaluation, Vegetation effects.

Although the Arizona Watershed Program's (AWP) research efforts have had considerable success over the past 22 years in its objective to further knowledge of the feasibility of vegetative manipulation and modification as a method of increasing surface water yields, its principal sponsor and supporter, the Arizona Water Resources (AWRC), has not, to date, met with similar success. Described are three of the AWRC's unsuccessful attempts to implement on-going action programs of vegetative management for water yield improvement: The Barr Report, the Ffolliott-Thorud Report, and the Globe Chaparral controversy, to illustrate how overstated program goals, unrealistic assumptions about the political feasibility of treatment types, extent, and intensity; failure to recognize the emergence of significant new decision-making participants, and unsettled questions concerning program costs and beneficiaries have contributed to setbacks in these programs. It is suggested that political as well as scientific constraints have accounted for reported failures in the implementation of the AWP action program objectives. (Tickes-Arizona)  
W80-00275

#### RAINFALL-RUNOFF RELATIONSHIPS FOR A MOUNTAIN WATERSHED IN SOUTHERN ARIZONA

Arizona Water Resources Research Center, Tucson.

M. Myhrman, C. B. Cluff, and F. Putman.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 165-170, 1 fig, 1 tab, 4 ref.

Descriptors: \*Rainfall-runoff relationships, \*Water resources development, \*Alternative planning, \*Surface runoff, \*Damsites, \*Water harvesting, Storage, Water demand, Water supply, Runoff, Water conservation, Water yield improvement, Drainage area, Reservoir storage, Computer models, Arizona.

Based upon the need for additional water to meet the projected growth and demand of the Smithsonian Institution's Mt. Hopkins Astrophysical observatory in the Santa Rita Mountains, the present study was initiated to identify alternative water supply sources in this area. The study initially focused on Cottonwood Canyon due to its proximity to the Observatory's facilities, historical record of significant surface flow, and the presence of several practical dam sites; and a second alternative of a paved water harvesting catchment on a flat area near the summit of Mt. Hopkins. As the study progressed the focus gradually shifted from Cottonwood Canyon to a smaller unnamed drainage immediately to the south due to the presence in this drainage of a ready-made storage reservoir created by the replacement of fill during the road building process. In light of these excellent reservoir sites and the ease with which the road system within this drainage could be developed as a water harvesting system, the options being considered for Cottonwood Canyon and a paved catchment near the summit were abandoned and it was recommended that the two storage reservoirs be constructed with the upper reservoir serving for both water storage and for trapping the inevitable sediment load. A computer model was used to simulate the operation of the proposed system over a 12 year period. (Tickes-Arizona)  
W80-00290

#### 3C. Use Of Water Of Impaired Quality

#### WASTEWATER EFFLUENT-AN ELEMENT OF TOTAL WATER RESOURCE PLANNING

Boyle Engineering Corp., Phoenix, AZ.

J. D. Goff.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 115-119.

Descriptors: \*Effluents, \*Planning, \*Water reuse, \*Alternative planning, Water demand, Wildlife management, Groundwater recharge, Recreation, Water supply, Industrial water, Cooling water, Comprehensive planning, Irrigation, Phoenix, Arizona, Powerplants.

Wastewater effluent utilization, a potentially major factor in solving the water supply needs for metropolitan Phoenix, is analyzed in terms of the various reuse options presently being studied including agricultural irrigation, fish and wildlife enhancement, groundwater recharge, industrial processing and cooling water, recreation, cooling water for power generation stations, and exchanging effluent for additional water supplies. It is concluded that if controlled reuse is to be planned in the interest of increasing the future public water supply, close cooperation is needed among all who will participate. (Tickes-Arizona)  
W80-00284

#### 3D. Conservation In Domestic and Municipal Use

#### SALVAGING WASTED WATERS FOR DESERT-HOUSEHOLD GARDENING

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.

D. H. Fink, and W. L. Ehrler.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az., p 125-131, 5 tab, 3 fig, 6 ref.

Descriptors: \*Wastewater disposal, \*Water reuse, \*Reclaimed water, \*Water conservation, \*Rainfall-runoff relationships, \*Water harvesting, \*Surface runoff, \*Surface water availability, Water supply development, Water management(Applied), Water yield improvement, Runoff, Arid climates, Surface sealing, Irrigation techniques.

With the objective of determining if sufficient water would be salvaged by a typical desert, urban-household from normally wasted sources associated with the lot and household to adequately irrigate a garden and orchard, a 2000 sq ft house on a typical one fifth acre lot in three cities having climates similar to Phoenix, Tucson, or Prescott, Arizona was hypothesized and the amount of water available for yard watering calculated, provided that (1) only rainfall was available, (2) rainfall-runoff from covered areas associated with or adjacent to the lot was salvaged (roof, street, alley etc.), (3) gray-water from the household was utilized, (4) a portion of the lot was waterproofed to concentrate the runoff on the untreated portion, and (5) various combinations of the above were utilized to increase the amount of available water. It is demonstrated that these sources could be used singly or in combination to obtain the required amount of water with the actual amount available depending upon the precipitation, runoff and runoff areas, runoff efficiency of the contributing area, and the number of people in the household. A number of horticultural plants are suggested that should best fit such an irregular irrigation scheme. (Tickes-Arizona)  
W80-00285

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3E—Conservation In Industry

#### 3E. Conservation In Industry

**PROCEEDINGS OF THE 8TH NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES, MARCH 30-APRIL 1, 1977, SEATTLE, WASHINGTON.**

For primary bibliographic entry see Field 5D. W80-00116

**EFFLUENT POLISHING AND WASTEWATER REUSE AT SNOKIST GROWERS CANNERY, Eavelt Environmental Engineering, Spokane, WA.**  
For primary bibliographic entry see Field 5D. W80-00118

**TOMATO CLEANING, WATER RECYCLE AND MUD DEWATERING,**  
National Canners Association, Berkeley, CA.  
For primary bibliographic entry see Field 5D. W80-00120

**EFFLUENT GENERATION, ENERGY USE AND COST OF BLANCHING,**  
Science and Education Administration, Albany, CA. Western Regional Research Center.  
For primary bibliographic entry see Field 5D. W80-00122

**WASTE REDUCTION BY PROCESS MODIFICATION IN SWEET CORN PROCESSING,**  
Science and Education Administration, Albany, CA. Western Regional Research Center.  
G. H. Robertson, M. E. Lazar, J. M. Krochta, and D. F. Farkas.

In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 137-146, 1977. 5 tab, 5 ref.

Descriptors: \*Food processing industry, \*Industrial wastes, \*Effluent streams, \*Operations, \*Sweet corn, Water conservation, Industrial water, Water consumption (Except consumptive use).

Effluent and yield comparisons were made for intact kernels and cut kernels of sweet corn, and experimental processing methods were evaluated relative to their potential for a full-scale operation. Normal-depth cut kernels, deeply cut kernels, hole-sawed and screened kernels, and pressed kernels were produced and washed in a shaker washer. The kernels were blanched and air cooled. Wash water and blanching water were collected, measured, and measurements were recorded. Intact kernel mixtures provided for substantial effluent reductions over the conventionally cut kernel mixtures. Intact kernels produced by pressing had substantially greater yields and provided for the highest yield with the lowest effluent of the four experimental methods. (See also W80-00116) (Small-FRC) W80-00125

**AN EFFECTIVE WASTEWATER MANAGEMENT PROGRAM FOR A FOOD PROCESSOR,**  
Eutek, Inc., Sacramento, CA.  
For primary bibliographic entry see Field 5D. W80-00130

**REDUCTION OF WASTES FROM CUCUMBER PICKLE PROCESSING BY USE OF THE CONTROLLED CULTURE FERMENTATION PROCESS,**  
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.  
For primary bibliographic entry see Field 5D. W80-00139

**WATER REUSE OF WASTEWATER FROM A POULTRY PROCESSING PLANT,**  
Pittsburgh Univ., PA.  
For primary bibliographic entry see Field 5D. W80-00142

**WATER REUSE IN POULTRY PROCESSING: CASE STUDY IN EGYPT,**  
Alexandria Univ. (Egypt). Higher Inst. of Public Health.  
For primary bibliographic entry see Field 5D. W80-00143

#### 3F. Conservation In Agriculture

**TRICKLE IRRIGATION: PREVENTION OF CLOGGING,**  
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.  
For primary bibliographic entry see Field 5F. W80-00074

**RISE IN ENERGY PRICES, WATER DEMAND BY PERIURBAN AGRICULTURE, AND IMPLICATIONS FOR URBAN WATER SUPPLY: THE TUCSON CASE,**  
Science and Education Administration, Phoenix, AZ. Natural Resources Economics Div.  
H. W. Ayer, and D. W. Gapp.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science Vol. 8, April 14-15, 1978, Flagstaff, Az. p 194-201, 6 tab, 17 ref.

Descriptors: \*Costs, \*Cost-benefit analysis, \*Economic prediction, \*Economic justification, \*Water supply, Hydrologic budget, Urban hydrology, Water rates, Groundwater budget, Political constraints, Linear programming, Irrigation water, Municipal water, Competing uses, Legal aspects, Tucson, Arizona, Associated costs, Electric power costs.

The city of Tucson, Arizona, the largest city in the U.S. to meet its water needs entirely from diminishing underground sources, is presently experiencing increasing water rates and the political turmoil associated with those increases. With focus upon this increasingly serious problem, production function analysis and static linear programming are used here to estimate the impact of rising energy prices on farm profits, cropping patterns and irrigation water used in the Avra Valley, a periurban irrigated region adjacent to Tucson, in an effort to evaluate the impact of this community upon Tucson's municipal water demand. It is concluded that as energy prices increase and land is removed from agricultural production within the Avra Valley, Tucson's economic position will be bolstered in at least three ways: (1) there will be more water available, (2) the price which the city must pay for farmland in order to gain control of the underlying water should be diminished and the quantity of farmland for sale increased, and (3) with fewer people involved in irrigated agriculture, legal conflicts between competing users will be diminished. (Ticks-Arizona) W80-00295

#### 4. WATER QUANTITY MANAGEMENT AND CONTROL

##### 4A. Control Of Water On The Surface

**PROCEEDINGS, URBAN STORMWATER MANAGEMENT SEMINARS, ATLANTA, GEORGIA, NOVEMBER 4-6, 1975 AND DENVER, COLORADO, DECEMBER 2-4, 1975.**  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-260 889. Price codes: A22 in paper copy, A01 in microfiche. Environmental Protection Agency Washington D.C., WPD 03-76-01, 1976. 509 p.

Descriptors: \*Storm runoff, \*Project planning, \*Watershed management, \*Pollutant identification, \*Legal aspects, Urban runoff, Storm water, Local governments, Water pollution control, Financing,

Detention reservoirs, Waste water treatment, Waste water disposal, Municipal wastes.

Papers presented at the Urban Stormwater Management Seminars discussed the characterization of the urban stormwater problem, approaches to the urban stormwater problem, and institutional and legal aspects of urban stormwater management. A total of 23 papers are included with question and response sessions following many. The seminars were conducted to provide an overview of the urban stormwater problem and to assist agencies in the implementation of 208 planning in various regions. (See W80-00044 thru W80-00068) (Lisk-FRC) W80-00043

**BEST MANAGEMENT PRACTICES,**  
Environmental Protection Agency, Washington, DC. Water Planning Div.  
D. Athayde.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975. p 1-2, 6, 1976.

Descriptors: \*Urban runoff, \*Storm water, \*Water pollution sources, \*Storage, Organic matter, Heavy metals, Microorganisms, Nutrients.

The best management practices for the prevention of urban runoff are discussed. Polluted urban runoff contains organic material, inorganic material, nutrients, heavy metals, and microorganisms. Preventive methods can reduce stormwater pollution before runoff accumulates and enters the sewer system or through management and alteration of the collection system. The preventive approach focuses on developing areas and attempts to preserve the watershed's existing runoff characteristics. The preventive approach is less costly than storage and treatment of collected stormwater runoff. (See also W80-00043) (Small-FRC) W80-00044

**CONSIDERATIONS IN CHARACTERIZATION OF URBAN RUNOFF FOR PL 92-500 SECTION 208 PLANNING,**  
Environmental Protection Agency, Washington, DC. Office of Research and Development.  
F. J. Condon.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-9, 32, 1976. 2 fig, 13 ref.

Descriptors: \*Urban runoff, \*Publications, \*Mathematical models, \*Project planning, Storm water, Sampling, Analytical techniques, Water pollution sources, Federal Water Pollution Control Act.

An overview is presented on characterizations of urban runoff applicable to Section 208 planning from several Environmental Protection Agency reports. The importance of data to the planner as opposed to mathematical modeling results is discussed. Considerations when planning data collection are presented including types of measurements, sampling conditions, and necessary synchronous data. Recommended procedures are outlined for storm-generated discharge projects. Analytical techniques and useful characteristics to be determined are discussed, and eighteen models are mentioned. (See also W80-00043) (Small-FRC) W80-00045

**INSTREAM IMPACTS OF URBAN RUNOFF,**  
E. D. Driscoll.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-54-76, 1976. 6 fig.

Descriptors: \*Urban runoff, \*Storm water, \*Project planning, Water pollution sources, Water pollution control, Sampling, Analytical techniques.

Instream impacts of urban stormwater runoff are discussed in general and planning for pollution control is considered. Planning must identify the

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Control Of Water On The Surface—Group 4A

problem in the receiving water by determining pollutant loads and receiving water characteristics. A study approach should include data collection and analytical procedures. (See also W80-00043) (Small-FRC) W80-00046

#### LAND USE AND URBAN DEVELOPMENT AFFECTING STORMWATER POLLUTION AND WATER QUALITY

Poertner (Herbert G.), Bolingbrook, IL. H. G. Poertner. In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-38-53, 1976. 3 fig. 1 tab, 13 ref.

Descriptors: \*Urban runoff, \*Storm water, \*Precipitation (Atmospheric), Water pollution sources, Biochemical oxygen demand, Suspended solids, Waste water treatment, Land use, Microorganisms.

Assessment of pollution in stormwater runoff as a function of land use and urban development is discussed. Most stormwater runoff quality information is given as mean pollutant concentration or averages of samples taken from one or more runoff events. The relationships between rainfall, runoff, and time variations of other parameters are important but are not considered. Average-type data have characterized urban stormwater runoff as having a solids concentration equal to or greater than raw sewage, BOD concentrations equal to that of effluents from secondary treatment, and bacterial contamination 2 to 4 times less than that of untreated sewage. (See also W80-00043) (Small-FRC) W80-00047

#### IMPACT OF CSO/SSD ON WATER QUALITY

Metcalf and Eddy, Inc., Palo Alto, CA. J. A. Lager. In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-83-96, 1976. 5 fig. 7 ref.

Descriptors: \*Combined sewers, \*Urban runoff, \*Mathematical models, \*Monitoring, Water pollution sources, Storm water, Storm runoff.

The impacts of combined sewer overflows and storm sewer discharges on receiving waters are discussed. Investigations have primarily been limited to the impacts of aesthetics, contamination, and point source loadings, while modeling studies and continuous monitoring at key locations should be used. Examples of urban runoff impacts are discussed for San Francisco, Minneapolis-St. Paul, and Greater Seattle. Modeling results are discussed for Washington, D.C., Chicago, Reno, and Rochester. (See also W80-00043) (Small-FRC) W80-00048

#### NON-POINT SOURCE IMPACT AND URBAN HOLDING CAPACITY

GKY and Associates, Alexandria, VA. For primary bibliographic entry see Field 4C. W80-00049

#### RUNOFF AND QUALITY

For primary bibliographic entry see Field 4C. W80-00050

#### APPLICATIONS OF STORMWATER MANAGEMENT MODELS

Metcalf and Eddy, Inc., Palo Alto, CA. J. A. Lager. In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-157-178, 1976. 4 fig. 3 tab, 4 ref.

Descriptors: \*Storm water, \*Mathematical models, \*Project planning, Water quality, Costs, Storm runoff, Sampling.

The application of stormwater management models is discussed from the viewpoint of model selection. The selection procedure includes the definition of study objectives which means determining what improvement in water quality is needed, how much, and where. The required sensitivity of results and the assessment of existing data are discussed. Data are provided on comparisons of urban runoff models. A comprehensive program included verification of sampling costs at about \$200,000 to \$500,000. The most cost-effective utilization of modeling combines simplified and dynamic models in a single program. (See also W80-00043) (Small-FRC) W80-00051

#### LAND MANAGEMENT TECHNIQUES FOR STORMWATER CONTROL IN DEVELOPED URBAN AREAS

Environmental Protection Agency, Washington, DC. Water Planning Div. For primary bibliographic entry see Field 4C. W80-00052

#### COST EFFECTIVE APPROACH FOR COMBINED STORM AND SEWER CLEAN-UP

Energy and Environmental Analysis, Inc., Boston, MA. W. C. Pisano.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 11-62-82, 1976. 4 fig. 3 tab.

Descriptors: \*Urban runoff, \*Sewerage, \*Storm water, \*Suspended solids, \*Coliforms, Urban drainage, Watershed management, Water pollution sources, Mathematical models, Chlorination.

An overview is presented of a recent assessment of the cost-effectiveness of several alternative plans for reducing the frequency and magnitude of combined sewer overflows from two large, densely populated communities in Boston. Controls included wet and dry weather field sewer inspections, sewer flushing, off-line storage, and chlorination facilities. Beneficial and cost-effective remedial measures were yielded. A methodology was developed which predicted solids deposition in 0.5 million feet of collection systems covering 3000 acres. Daily predicted solids were reduced by 50% by daily flushing of 100 critical segments. The addition of off-line storage reduced pollutant loads. Marine coliform levels were monitored and in situ coliform death experiments were performed. The impacts of various fecal contamination control strategies were evaluated using the Boston Harbor water quality simulation model. (See also W80-00043) (Small-FRC) W80-00055

#### COLLECTION SYSTEM CONTROL

Metcalf and Eddy, Inc., Palo Alto, CA.

J. A. Lager. In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 11-83-94, 1976. 3 fig. 8 ref.

Descriptors: \*Urban runoff, \*Storage, \*Sewerage, \*Waste water treatment, Storm water, Urban drainage, Costs, Pilot plants.

The basic concepts of collection system control are reviewed, problems in test applications are described, and the system's cost-effectiveness is evaluated. The system utilizes in-system storage and flow routing to optimize the collection and treatment of wet weather flows. Inflatable dams are used to increase storage under normal flow conditions. The Metropolitan Seattle system includes water quality monitoring and advanced control functions. It has 15 fully equipped regulation stations and one major pumping station. Maximum safe storage is equivalent to 0.05 inches of runoff. The system has reduced peak loadings by 80 to 90%. The system cost \$5.3 million which includes computer controls and station control equipment. (See also W80-00043) (Small-FRC) W80-00056

#### A COST-EFFECTIVE SWIRL COMBINED SEWER OVERFLOW REGULATOR/SOLIDS-SEPARATOR

Municipal Environmental Research Lab., Cincinnati, OH. R. I. Field.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 11-99-111, 1976. 13 fig. 1 tab, 9 ref.

Descriptors: \*Treatment facilities, \*Combined sewers, \*Urban runoff, \*On-site tests, Storm water, Costs, Suspended solids, Biochemical oxygen demand, Performance.

The dual functioning swirl unit is described which is the first regulator device of its type to offer the advantage of simultaneous control of the quality and quantity of combined sewer overflow. The facility is simple in design and economical to operate. It effectively reduces grit, settleable solids, BOD-5, and floatables. Performance is reviewed of a 3.5 m diameter swirl combined sewer overflow regulator in Syracuse, N. Y., which treats a 54-acre, single family residential area. Hydraulic model studies indicated that suspended solids removal efficiency of the swirl unit is 65%. Prototype total mass loading and concentration removal efficiency ranged from 44 to 65% and 18 to 55%, respectively. Capital costs were \$55,000 with \$2,000/year operation and maintenance costs. (See also W80-00043) (Small-FRC) W80-00057

#### A REVIEW OF EPA'S URBAN RUNOFF POLLUTION CONTROL RESEARCH PROGRAM

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 11-112-117, 1976. 2 ref.

Descriptors: \*Research programs, \*Pilot plants, \*Storm runoff, \*Watershed management, \*Sewerage, Urban runoff, Storm water, Water pollution sources, Water treatment, Mathematical models.

The Environmental Protection Agency's Storm and Combined Sewer Pollution Control Research Development and Demonstration Program is described. It includes more than 140 projects totaling about \$100 million. The program is comprised of problem definition and development of effective control alternatives. Control methods include source control, sewerage system control, treatment, integrated systems, and computer models. (See also W80-00043) (Small-FRC) W80-00058

#### URBAN STORMWATER DETENTION AND FLOW ATTENUATION FOR POLLUTION CONTROL

Poertner (Herbert G.), Bolingbrook, IL. H. G. Poertner.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 11-118-146, 1976. 5 fig. 6 ref.

Descriptors: \*Storm water, \*Storm runoff, \*Storage, \*Project planning, Water pollution sources, Waste water treatment, Legislation, Suspended solids, Urban runoff.

Properly operated stormwater detention facilities reduce or abate downstream water pollution and flooding. Detention reduces the pollution to receiving waters caused by suspended solids and sediments. Guidelines are presented for public agencies involved in designing, planning, or implementing stormwater management systems. First, the extent of pollution should be determined, a regional approach should be used to develop a master plan, and suitable legislation should be enacted. One of the most significant aspects is the selection of space for the temporary storage of runoff. (See also W80-00043) (Small-FRC) W80-00059

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**URBAN STORMWATER MANAGEMENT PROBLEMS AND SOLUTIONS—OVERVIEW OF A NATIONWIDE STUDY.**  
Poertner (Herbert G.), Bolingbrook, IL.  
H. G. Poertner.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-2-14, 1976.

Descriptors: \*Project planning, \*Storm runoff, \*Urban runoff, \*Watershed management, Water pollution sources, Storm water, Urban drainage.

Institutional urban and metropolitan stormwater management problems which delay or prevent effective and economical programs from being developed, are discussed. Solutions, proposed and real, are also reviewed. Data were collected through personal interviews in many areas and detailed case studies in Denver, Chicago, and the Washington D. C. suburbs of Virginia are presented. Most areas contacted lacked a master stormwater management plan, and financing was normally the greatest impediment or at least a major problem. Public education, especially education to accept financial responsibility, was generally lacking. (See also W80-00043) (Small-FRC) W80-00060

**THE INTERGOVERNMENTAL TANGLE FACING STORMWATER CONTROL.**  
Environmental Protection Agency, Washington, DC. Water Planning Div.  
For primary bibliographic entry see Field 4D. W80-00061

**STATE/LOCAL INTERACTION IN STORM-WATER MANAGEMENT.**  
Virginia State Water Control Board, Richmond. E. T. Jensen.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-45-56, 1976.

Descriptors: \*Urban runoff, \*Management, \*Storm water, \*Virginia, \*Cost analysis, Project planning, Water pollution sources, Public benefits, Legislation, Waste water treatment, Municipal wastes.

Problems with stormwater management in Virginia are discussed. Mechanisms considered to increase public awareness of the need for stormwater management include severe flooding or drainage problems, water supply degradation, downstream water quality, and legislative declarations. Cost-effectiveness and public acceptance are considered severe constraints of alternative solutions to runoff problems. Major programs developed in 10 districts and counties of Virginia are cited. The roles of state, local, and federal governments in developing and managing stormwater programs are reviewed. (See also W80-00043) (Lisk-FRC) W80-00062

**LEGAL ASPECTS OF URBAN STORMWATER MANAGEMENT.**  
Shoemaker and Wham, Denver, CO.  
W. J. Shoemaker.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-57-66, 1976. 2 ref.

Descriptors: \*Urban runoff, \*Storm water, \*Legal aspects, \*Storm runoff, \*Real property, Overland flow, Governments, Watershed management, Municipal wastes.

The legal aspects of urban stormwater drainage and its management are discussed. Traditionally, owners of lower lying properties have been required to accept the stormwater runoff from upper properties. The lower property owner was required to accept no more water than would naturally flow onto the property. Stormwater runoff has had an impact on property values; property rights have a significant control on stormwater management, unless health and safety are affected.

The relationship of stormwater management and various state, local, and federal agencies is reviewed. (See also W80-00043) (Lisk-FRC) W80-00063

**LEGAL ASPECTS OF URBAN STORM WATER MANAGEMENT AND RELATED POLLUTION ABATEMENT PROBLEMS.**  
F. E. Maloney.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-67-106, 1976. 115 ref.

Descriptors: \*Storm runoff, \*Legal aspects, \*Urban runoff, \*Storm drains, \*Detention reservoirs, Legislation, Federal Water Pollution Control Act, Real property, Water pollution control, Watershed management, Municipal wastes.

The legal aspects of providing more and larger storm sewers, temporary stormwater detention in higher areas, and upgrading storm and combined sewers are reviewed. The problems of disposal of stormwater and the legal effects of the pollution problem are also discussed. Civil law rule, common enemy rule, and the doctrine of reasonable use are evaluated in terms of stormwater management approaches. The increased flow over lowlands, drainage into natural watercourses, and theories of action and legal remedies are also discussed. Problems with stormwater detention, the control of pollution in relation to stormwater management, common law development, and water pollution legislation are reviewed. The goals, enforcement and citizen suits, point and nonpoint sources, and navigable waters involved with the Federal Water Pollution Control Act are also discussed. (See also W80-00043) (Lisk-FRC) W80-00064

**FINANCING STORM WATER CONTROL PROJECTS.**  
J. Fountain, and D. Cochran.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-107-112, 1976.

Descriptors: \*Financing, \*Watershed management, \*Storm runoff, \*Costs, \*Project planning, Cost-benefit analysis, Income, Taxes, Urban runoff, Municipal wastes.

Methods of financing stormwater improvements and an evaluation and design criteria are reviewed. Traditional methods of funding stormwater improvements considered include: current ad valorem property taxes, general obligation bonds issues, special assessments, private funds from developers, revenue sharing and community development act funds, and the use of water and sewer revenue bonds and renewal and extension funds. Criteria for evaluating the various funding techniques include the effects of the expenditures on other programs, identification of the beneficiaries of the program, and the program efficiency. The advantages and disadvantages of the programs are briefly reviewed. (See also W80-00043) (Lisk-FRC) W80-00065

**FINANCING STORMWATER PROJECTS.**  
Shoemaker and Wham, Denver, CO.  
W. J. Shoemaker.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-113-121, 1976. 2 ref.

Descriptors: \*Financing, \*Watershed management, \*Storm runoff, \*Legal aspects, \*Urban runoff, Project planning, Costs, Storm drains, Cost-benefit analysis, Waste water treatment, Municipal wastes.

A discussion of stormwater management program financing is presented. Financing of stormwater drainage projects may be assisted when public facilities, such as parks, and recreational and health facilities are incorporated. A definition of the term,

benefit, for evaluation of drainage projects is considered necessary and an assessment is developed. Descriptions of existing programs are provided. (See also W80-00043) (Lisk-FRC) W80-00066

**PLANNING TO NARROW THE IMPLEMENTATION GAP.**  
Municipality of Metropolitan Seattle-METRO, WA.  
P. Wilson.

In: Proceedings of Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-122-131, 1976.

Descriptors: \*Project planning, \*Storm runoff, \*Urban runoff, \*Local governments, \*Environmental effects, Analytical techniques, Watershed management, Planning, Municipal wastes.

Recommendations for reducing the gap between the planning and implementation of stormwater management programs are presented. The planning of programs should be as close to the implementation stages as possible, especially in areas of cost-effectiveness, institutional arrangements, and financial alternatives. The development of a framework of planning that incorporates operating agencies, regional planning agencies, and implementing agencies is urged; the identification of goals, objectives, policies, and the use of demographic data and projections based on timing and location of growth and development are recommended. Collaborative planning approaches assist in implementation. Critical analysis and evaluation of the planning should be conducted utilizing the environmental impact assessment process. Public participation in the planning effort is urged. (See also W80-00043) (Lisk-FRC) W80-00067

**IMPLEMENTATION OF URBAN STORM-WATER RUNOFF PLANS.**  
Southeastern Wisconsin Regional Planning Commission, Waukesha.  
G. C. Berteau.

In: Proceedings of Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-132-140, 1976.

Descriptors: \*Project planning, \*Storm water, \*Urban runoff, \*Watershed management, \*Wisconsin, Storm runoff, Planning, Water pollution control, Legal aspects, Local governments, Waste water treatment, Municipal wastes.

Considerations and factors in the implementation of stormwater management projects are reviewed. Definitions are provided for conveyance facilities, effluent limitations, nonpoint sources, water pollution, water quality, urban area, and waste treatment planning agencies. A comprehensive stormwater management program should incorporate a total watershed or basin plan which considers natural resource protection, flood control, and water pollution abatement. Plans that have been developed and/or implemented in Wisconsin are reviewed. An agreed upon plan should have a schedule of implementing required capital improvements, should be prepared by a technically competent agency with areawide jurisdiction, should have the approval of the area's political, environmental, and economic leaders and the support of the public. (See also W80-00043) (Lisk-FRC) W80-00068

**SURFACE WATER DATA MANITOBA 1978.**  
Department of the Environment, Ottawa (Ontario). Water Resources Branch.  
1979, 169 p, in English and French.

Descriptors: \*Data collections, \*Stream gages, \*Gaging stations, \*Flow rates, \*Water levels, \*Flow measurement, Natural flow, Surface waters, Ice, Discharge measurement, Discharge (Water), Hydrologic data, Drainage area, \*Manitoba.

The Water Resources Branch of the Department of the Environment presents for the 1978 calendar

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Effects On Water Of Man's Non-Water Activities—Group 4C

year, the results of the hydrometric survey investigations which were made in Manitoba by the Water Survey of Canada. Tables containing information on daily water levels of discharge, summaries of monthly and annual data, and descriptive information are presented for each gauging station. Descriptive information includes type of gauge, location and drainage area. (WATDOC) W80-00195

**SURFACE WATER DATA YUKON AND NORTHWEST TERRITORIES 1978.**  
Department of the Environment, Ottawa (Ontario). Water Resources Branch.  
1979, 82 p, in English and French.

Descriptors: \*Data collections, \*Stream gages, \*Gaging stations, \*Flow rates, \*Water levels, Flow measurement, Natural flow, Surface waters, Ice, Discharge measurement, Discharge (Water), Hydrologic data, Drainage area, \*Yukon Territory, \*Northwest Territories.

The Water Resources Branch of the Department of the Environment presents for the 1978 Calendar year, the results of the hydrometric survey investigations which were made in the Yukon and Northwest Territories by the Water Survey of Canada. Tables containing information on daily water levels of discharge, summaries on monthly and annual data, and descriptive information are presented for each gauging station. Descriptive information includes type of gauge, location and drainage area. (WATDOC) W80-00196

**EFFECTIVENESS OF SEALING SOUTHEASTERN ARIZONA STOCK PONDS WITH SODA ASH.**

Science and Education Administration, Tucson, AZ. Southwest Rangeland Watershed Research Center.  
H. B. Osborn, J. R. Simanton, and R. B. Koehler.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 73-78, 3 tab, 5 fig, 2 ref.

Descriptors: \*Ponds, \*Seepage control, \*Soil sealants, Sodium carbonate, Stock water, Clays, Porosity, Soil chemistry, Soil treatment, Arizona.

Pond seepage losses are a particularly serious problem in the semiarid southwest where runoff-carried calcium normally causes well-dispersed clay particles to aggregate and increase the porosity of stock pond sediments. Reported are the results of laboratory and field tests carried out by the USDA Water Conservation Laboratory in Phoenix, Arizona to determine the success of sodium carbonate (soda ash) as a soil sealant and to establish criteria for its use. Following tests two leaky ponds on Walnut Gulch, Arizona were treated with soda ash broadcast over the dry pond surfaces to the spillway elevation at a rate of 3365 Kg/ha and mixed with the pond sediment to a depth of 10 cm with a disc. Seepage losses were compared following the summer rainy season, and generally represent 20 day periods in September or October when the summer monsoon rains have ended. The late season seepage loss for the after treatment period each year from 1968 through 1974 was reduced about 50% and the treatment on one pond seems to have lasted much longer than anticipated, thus increasing the value of the treatment. A pretreatment laboratory seepage test is suggested to better determine the likelihood of treatment success. (Tickes-Arizona) W80-00278

#### 4B. Groundwater Management

**MONITORING OF SUBSURFACE INJECTION OF WASTES, FLORIDA.**

Geological Survey, Tallahassee, FL. Water Resources Div.  
For primary bibliographic entry see Field 5B.

W80-00222

**USE OF DIGITAL MODELS TO MANAGE GROUNDWATER.**

Fox (F.M.) and Associates, Inc., Spokane, WA.  
For primary bibliographic entry see Field 2F.  
W80-00252

**HYDROLOGIC FACTORS AFFECTING GROUNDWATER MANAGEMENT FOR THE CITY OF TUCSON, ARIZONA.**

Arizona State Water and Sewer Dept., Tucson.  
R. B. Johnson.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, April 14-15, 1978, Flagstaff, AZ, Vol. 8, p 1-8, 6 fig, 3 ref.

Descriptors: \*Hydrologic properties, \*Water supply, \*Water wells, \*Groundwater availability, \*Water budget, \*Urban hydrology, Water utilization, Groundwater mining, Water allocation, Water table, Hydrologic aspects, Comprehensive planning, Pumping, Costs, Subsidence, Water quality, Areal hydrogeology, Tucson, Arizona.

Both the positive and negative aspects of Tucson, Arizona's total dependence upon groundwater are examined in this assessment of the basic hydrologic and geologic parameters which presently control the occurrence and availability of the city's water resources. Each of the several relevant parameters for Tucson's Interior, Southside, Santa Cruz, and Avra Valley well fields are evaluated, both individually and in combination, in an effort to supply the basis for a future comprehensive water plan. The relationship between documented water level declines and observed decreases in the production capacity of these major well fields are established and the additional effects of pumping costs, subsidence, and water quality considered in formulating management alternatives. It is concluded that while the present production levels of the Interior field should be reduced, increased withdrawals from the Avra Valley represents the best alternative course of action at the present time. (Tickes-Arizona) W80-00269

**OPTIMIZATION OF A DAM SYSTEM FOR RECHARGING RUNOFF WATER INTO THE GROUND.**

Tahal Consulting Engineers Ltd., Haifa (Israel).  
A. Nov, and P. Golany.  
Water Resources Research, Vol. 15, No. 4, p 891-898, August 1979. 2 fig.

Descriptors: \*Dams, \*Recharge, Runoff, \*Optimization, \*Dynamic programming, \*Cost minimization, Wells, Reservoirs, Groundwater, Hydrologic aspects, Annual yield, Flood routing, Equations, Mathematical models, Systems analysis, Mountainous catchments.

Presented is a method for a routine determination of an optimal combination of small dams in mountainous catchments. The method is meant for arid and semiarid climates, where wells are the main source of water. The objective of the dams is to impound runoff water and recharge it, through the reservoirs formed by them, into the ground, thereby augmenting the natural replenishment of groundwater. The objective function calls for a minimization of the cost of the recharged water. The optimization technique is dynamic programming. The method is confined to the mathematical formulation of the optimization procedure. Although this formulation is made in terms of the hydrological and geometrical variables concerned, no reference is made to the hydrological and structural information; it is assumed that this information is available. A purposeful use of this optimization method requires appropriate methods (yet to be proposed) of supplying and processing the vast hydrological information necessary. The results obtained from application of the method (the cost of recharged water and a description of the corresponding dam system) are given for different, arbitrary selected average annual recharge volumes up to the total average annual runoff yield of the catchment. From a rigorous formal point of view, the method violates the principles of dynamic programming. This violation becomes permissible owing to certain controls inherent in the process, regulating it from within. (Bell-Graf-Cornell) W80-00362

**CONTROLS AND REMEDIES FOR GROUND WATER - CAUSED LAND SUBSIDENCE.**  
For primary bibliographic entry see Field 6E.  
W80-00389

#### 4C. Effects On Water Of Man's Non-Water Activities

**STREAM CHANNEL MODIFICATION IN HAWAII. PART A: STATEWIDE INVENTORY OF STREAMS: HABITAT FACTORS AND ASSOCIATED BIOTA.**

Hawaii Cooperative Fishery Research Unit, Honolulu.  
For primary bibliographic entry see Field 6G.  
W80-00003

**STREAM CHANNEL MODIFICATION IN HAWAII. PART B: EFFECT OF CHANNELIZATION ON THE DISTRIBUTION AND ABUNDANCE OF FAUNA IN SELECTED STREAMS.**

Hawaii Cooperative Fishery Research Unit, Honolulu.  
For primary bibliographic entry see Field 6G.  
W80-00004

**BEST MANAGEMENT PRACTICES.**

Environmental Protection Agency, Washington, DC. Water Planning Div.  
For primary bibliographic entry see Field 4A.  
W80-00044

**CONSIDERATIONS IN CHARACTERIZATION OF URBAN RUNOFF FOR PL 92-500 SECTION 208 PLANNING.**

Environmental Protection Agency, Washington, DC. Office of Research and Development.  
For primary bibliographic entry see Field 4A.  
W80-00045

**LAND USE AND URBAN DEVELOPMENT AFFECTING STORMWATER POLLUTION AND WATER QUALITY.**

Poertner (Herbert G.), Bolingbrook, IL.  
For primary bibliographic entry see Field 4A.  
W80-00047

**IMPACT OF CSO/SSD ON WATER QUALITY.**

Metcalf and Eddy, Inc., Palo Alto, CA.  
For primary bibliographic entry see Field 4A.  
W80-00048

**NON-POINT SOURCE IMPACT AND URBAN HOLDING CAPACITY.**

GKY and Associates, Alexandria, VA.  
G. K. Young.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p 1-98-115, 1976.

Descriptors: \*Mathematical models, \*Urban runoff, \*Storm water, Storage, Water pollution sources, Urban drainage, Combined sewers.

A simplified average water quality model is presented which encompasses waste generation and receiving water quality. The impacts of control options that are implied by the model are considered, and the effects of density in the urban area are discussed. The model is applied to a typical Florida situation and holding capacity constraints are developed. Decreasing non-point load through better housekeeping or improved grading practices

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4C—Effects On Water Of Man's Non-Water Activities

and improved planning through increased density are two ways to enhance water quality. The pollutant control model which focuses on an individual storm event is also described. Increasing storage capacity, and thus increasing the amount of reducing load of receiving waters, is effective. An increase of 10% in combined sewers decreases the load 1.3%. (See also W80-00043) (Small-FRC) W80-00049

#### RUNOFF AND QUALITY, E. D. Driscoll.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p I-122-144, 1976. 9 fig.

Descriptors: \*Project planning, \*Water quality, \*Urban runoff, \*Storm water, Precipitation (Atmospheric), Urban drainage, Storm runoff, Monitoring.

Programs for the local determination of runoff and water quality are considered. Variability in data occurs so a program must be selected to determine the relationship between local causes and variations. Careful spacing of rain gauges can reduce variations except for those related to storm or surface effects. A level of detail must be adopted that is consistent with the sensitivity of other elements in the analysis to the level of detail of the inputs. The study should concentrate on several small areas, flow measurement, and sampling stations should be located at a common point, and data should be collected on as many storm events as possible. The analysis should concentrate on the contaminants which have the most influence on receiving water. (See also W80-00043) (Small-FRC) W80-00050

#### LAND MANAGEMENT TECHNIQUES FOR STORMWATER CONTROL IN DEVELOPED URBAN AREAS,

Environmental Protection Agency, Washington, DC. Water Planning Div.  
K. Adgate.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p II-2-34, 1976. 12 tab, 17 ref.

Descriptors: \*Storm water, \*Urban runoff, \*Social aspects, \*Costs, Litter, Water pollution sources, Cleaning.

Alternative approaches to complete treatment of stormwater which are applicable to developed urban areas are discussed. Housekeeping techniques for abatement and control are discussed including street sweeping, improved trash collection, catch basin cleaning, sewer flushing, deicing material controls, and disconnection of roof leaders. These techniques are compared on socio- and cost-effective bases to aid in the selection of cost-effective control alternatives that are acceptable to the public. (See also W80-00043) (Small-FRC) W80-00052

#### COST EFFECTIVE APPROACH FOR COMBINED STORM AND SEWER CLEAN-UP, Energy and Environmental Analysis, Inc., Boston, MA.

For primary bibliographic entry see Field 4A. W80-00053

#### COLLECTION SYSTEM CONTROL, Metcalf and Eddy, Inc., Palo Alto, CA.

For primary bibliographic entry see Field 4A. W80-00056

#### URBAN STORMWATER MANAGEMENT PROBLEMS AND SOLUTIONS—OVERVIEW OF A NATIONWIDE STUDY, Poertner (Herbert G.), Bolingbrook, IL.

For primary bibliographic entry see Field 4A. W80-00060

#### EFFECTS OF MALATHION ON MICROORGANISMS OF AN ARTIFICIAL SALT-MARSH ENVIRONMENT, Environmental Research Lab., Gulf Breeze, FL.

For primary bibliographic entry see Field 2L. W80-00303

#### BIOGEOCHEMISTRY OF A FORESTED ECOSYSTEM, Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.

G. E. Likens, F. H. Bormann, R. S. Pierce, J. S. Eaton, and N. M. Johnson.  
Springer-Verlag, New York, 1977. 146 p, 31 fig, 22 tab, 152 ref.

Descriptors: \*Forests, \*Ecosystems, \*Geochemistry, \*Biology, \*Ecological effects, Hydrology, Streams, Watershed management, Watersheds (Basins), Drainage, Precipitation, Gases, Dynamics.

An in-depth analysis is presented of the biogeochemistry of any terrestrial ecosystem based upon the well-known 'Hubbard Brook' ecosystem studies. Long-term data is brought together for precipitation, stream-water chemistry, hydrology and weathering, and, the dynamics of atmospheric gases and water as they flow through the system are considered. Illustrated are the ways in which the ecosystem is affected by the three major biogeochemical vectors of the earth: air, water, and organisms. In turn, it is shown how the system moderates and changes inputs and how it affects biogeochemical cycles by its outputs. Acid precipitation is an important example of the ways in which inadvertent human activities influence atmospheric inputs in remote areas. Ecosystem control over biogeochemical functions is highly predictable and relatively repeatable from year to year. The original data from the Hubbard Brook studies are compared with data from diverse ecosystems throughout the world. (Steiner-Mass) W80-00328

### 4D. Watershed Protection

#### PROCEEDINGS, URBAN STORMWATER MANAGEMENT SEMINARS, ATLANTA, GEORGIA, NOVEMBER 4-6, 1975 AND DENVER, COLORADO, DECEMBER 2-4, 1975.

For primary bibliographic entry see Field 4A. W80-00043

#### LAND MANAGEMENT TECHNIQUES FOR DEVELOPING AREAS,

L. D. Bartee.  
In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p II-38-50, 1976.

Descriptors: \*Land management, \*Sedimentation, \*Storm runoff, \*Watershed management, Surface runoff, Legislation, Water pollution sources, Vegetation establishment, Land use, Erosion.

Land management techniques used by the Soil Conservation Service for developing areas which can minimize erosion and sediment problems are discussed. The Watershed Protection and Flood Prevention Program (Public Law 566) treats the watershed with conservation measures which catch and hold as much water as possible. Urban runoff can be reduced through the retention of lowlands or swamps for open space, construction of small retention dams, enlargement of ponds, and building terraces. Revegetation of disturbed areas is also considered. Two basic references: the Universal Soil Loss Equation and the Field Office Technical Guide, are described. (See also W80-00043) (Small-FRC) W80-00053

#### SCS PRACTICES AS RELATED TO SEDIMENT AND EROSION CONTROL, Soil Conservation Service, Athens, GA.

A. J. Dornbusch.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p II-56-61, 1976.

Descriptors: \*Surface runoff, \*Watershed management, \*Erosion control, \*Sedimentation, Water pollution sources, Land use, Vegetation establishment.

Soil Conservation Service practices related to sediment and erosion control for people or businesses with soil, water, and erosion problems, are discussed. The Soil Survey Report which provides mapping of soils all over the U. S., is described. The Universal Soil Loss Equation and its role in erosion control are discussed. Erosion control practices include the use of vegetation, water management through waterways, ponds, and irrigation systems. The Small Watersheds program and the Resources Development Program are briefly discussed. (See also W80-00043) (Small-FRC) W80-00054

#### THE INTERGOVERNMENTAL TANGLE FACING STORMWATER CONTROL,

Environmental Protection Agency, Washington, DC. Water Planning Div.  
A. B. Waldo.

In: Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975, and Denver, Colorado, December 2-4, 1975, p III-15-30, 1976. 1 ref.

Descriptors: \*Storm water, \*Urban runoff, \*Watershed management, \*Maryland, \*Local governments, Water pollution sources, Control, Cleaning, Waste water treatment, Municipal wastes.

The stormwater management programs in Montgomery County and Prince George County in Maryland are compared and various program strategies are reviewed. The Prince George program is controlled by a planning board consisting of the Soil Conservation District, the Park and Planning Commission, and the Department of Public Works. Montgomery County's program has been centralized within the Montgomery Soil Conservation District and incorporates long-range planning. Problems with both approaches to storm water management are reviewed. Control measures for best management practices (BMP) include street sweeping, erosion control practices, detention tanks, and catch basin cleaning. A characterization of the stormwater management problems in an area is required within the BMP concept. The role of intergovernmental cooperation in stormwater management is discussed. (See also W80-00043) (Lisk-FRC) W80-00061

#### STATE/LOCAL INTERACTION IN STORM- WATER MANAGEMENT,

Virginia State Water Control Board, Richmond. For primary bibliographic entry see Field 4A. W80-00062

#### LEGAL ASPECTS OF URBAN STORMWATER MANAGEMENT,

Shoemaker and Wham, Denver, CO.  
For primary bibliographic entry see Field 4A. W80-00063

#### LEGAL ASPECTS OF URBAN STORM WATER MANAGEMENT AND RELATED POLLUTION ABATEMENT PROBLEMS,

For primary bibliographic entry see Field 4A. W80-00064

#### FINANCING STORM WATER CONTROL PRO- JECTS,

For primary bibliographic entry see Field 4A. W80-00065

#### FINANCING STORMWATER PROJECTS, Shoemaker and Wham, Denver, CO.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

For primary bibliographic entry see Field 4A.  
W80-00066

**PLANNING TO NARROW THE IMPLEMENTATION GAP,**  
Municipality of Metropolitan Seattle-METRO, WA.  
For primary bibliographic entry see Field 4A.  
W80-00067

**IMPLEMENTATION OF URBAN STORM-WATER RUNOFF PLANS,**  
Southeastern Wisconsin Regional Planning Commission, Waukesha.  
For primary bibliographic entry see Field 4A.  
W80-00068

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

### 5A. Identification Of Pollutants

**RATE OF LOSS OF AMMONIA FROM WATER TO THE ATMOSPHERE,**  
Canada Centre for Inland Waters, Burlington (Ontario); and National Water Research Inst., Burlington (Ontario).  
For primary bibliographic entry see Field 2K.  
W80-00075

**POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE PESTICIDES IN GREAT LAKES PRECIPITATION,**  
Canada Centre for Inland Waters, Burlington (Ontario).  
W. M. J. Strachan, and H. Huneault.  
Journal of Great Lakes Research, Vol. 5, No. 1, p 61-68, 1979. 1 fig, 7 tab, 36 ref.

Descriptors: \*Chemistry of precipitation, \*Polychlorinated biphenyls, \*Pesticides, \*Great Lakes, \*Canada, Sampling, Chemical analysis, Watersheds(Basins), DDT, Dieldrin, Organic pesticides, Precipitation(Atmospheric), Rain, Snow, Water pollution, Pollutants, Path of pollutants, Organochlorine pesticides.

Snow samples from the winter of 1975-6 and rain samples (7 locations) from the period May-November 1976 were collected from around the Canadian side of the Great Lakes. All were examined for polychlorinated biphenyls and a range of organochlorine pesticides. The snow samples were time-integrated, being collected in February 1976. The rain samples were collected on an event basis, using stainless steel samplers with several complete events and the intervening dry-fall frequently being included in one sample. PCBs, lindane, alpha-BHC, DDT residues, Alpha- and beta-endosulfan, dieldrin, and methoxychlor were frequently found with mean rain levels of 21, 5, 12, 3, 2, 5, 1 and 8 ng/L, respectively. Concentrations in snow-melt were generally reduced from the rain values, except for PCBs. (Sims-ISWS)  
W80-00086

**EXAMINATION OF OIL-CONTAINING WASTE WATERS CHEMICAL COMPOSITION AFTER THEIR TREATMENT IN AERATION TANKS,**  
V. A. Panova, N. S. Goriatheev, and U. U. Lurie.  
In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 90-96, 1975. 2 fig, 4 tab.

Descriptors: \*Oily water, \*Oil wastes, \*Organic compounds, \*Pollutant identification, \*Aerated lagoons, Aeration, Volatility, Analytical techniques, Chemical oxygen demand, Oil industry, Waste water treatment, Industrial wastes.

The characteristics of effluent following aeration tank treatment of oil-containing waste waters were investigated. A new system of analysis permitted

the retention of volatile compounds in the waste waters for examination. Various oxygen-bearing organic compounds remained in biochemically treated waste water. The analysis extracted volatile and non-volatile acids including naphthenic and neutral compounds, such as hydrocarbons, quinones, alcohols, aldehydes, ketones, and esters; hydrophilic compounds included sugars, aminoacids, oxyacids, sulfonacids, and polyalcohols. The treated effluent contained about 10-15% of the initially present petroleum hydrocarbons and gas chromatography determined that they were compounds containing more than 14 carbon atoms in the molecule. A significant number of oxidation products remaining in the effluent contributed to the high COD of the waste water. The toxicity of the biochemically treated oil-bearing waste water was attributed to quinones, neutral compounds, mineral salts, and phenols reduced to quinones in the effluent. Increasing the detention time of the effluent was recommended. (See also W80-00097) (Lisk-FRC)  
W80-00107

**ALGAL ASSAYS FOR AREAS RECEIVING OR PROGRAMMED TO RECEIVE SEWAGE EFFLUENT,**  
Connecticut Univ., Storrs. Inst. of Water Resources.  
F. R. Trainor, and J. P. Grochowski.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 247. Price codes: A03 in paper copy, A01 in microfiche. Research Project Technical Completion Report, 1979. 25 p, 4 fig, 11 tab, 15 ref. OWRT A-076-CONN(1). 14-31-0001-8007.

Descriptors: \*Algae, \*Bioindicators, \*Chlorella, \*Benthic flora, Distribution, \*Effluents, Tertiary treatment, \*Algal assays, \*Nutrient uptake, \*Phosphate, Causal agent, \*Concrete substrate(CACO3), Selenastrum, Ankistrodesmus, Willimantic River, Connecticut.

Field study of a section of the Willimantic River in Eagleville revealed that Ankistrodesmus and Chlorella demonstrated a unique benthic distribution in the area of the University of Connecticut sewage effluent input. Ankistrodesmus dominates the effluent pipe and Chlorella dominates the plume once the effluent enters the river. Algal assays were performed and it was concluded that the substrate (concrete) was responsible for this distribution. More specifically CACO3 may be the causal agent in the concrete. Both organisms grew well in effluent but Ankistrodesmus growth rates were especially high in concentrated effluent. Nutrient-uptake assays were run and it was determined that Ankistrodesmus, alone or in mixed cultures with Chlorella or Selenastrum, removed the largest percentage of PO4 from the media. NO3 uptake was less conclusive due to the presence of other nitrogenous forms. Ankistrodesmus and Chlorella were grown together for 8 weeks in an attempt to determine the presence of an autoinhibitor or toxin affecting the growth rate of one or the other. No such toxin was detected. Ankistrodesmus was selected as the most suitable organism for natural tertiary treatment of wastewater because of its pollution tolerance, PO4 filtering capacity, and dominance of the study area throughout the year. (de Lara-Conn)  
W80-00193

**PERSPECTIVES ON LAKE ECOSYSTEM MODELING,**  
For primary bibliographic entry see Field 2H.  
W80-00204

**PREDICTIVE WATER QUALITY MODELS FOR THE GREAT LAKES: SOME CAPABILITIES AND LIMITS,**  
McMaster Univ., Hamilton (Ontario).  
For primary bibliographic entry see Field 2H.  
W80-00211

**PRELIMINARY INSIGHTS INTO A THREE-DIMENSIONAL ECOLOGICAL-HYDRODYNAMIC MODEL,**

Tetra Tech., Inc., Lafayette, CA.  
For primary bibliographic entry see Field 2H.  
W80-00214

**AN ANALYSIS OF PCB IN LAKE ONTARIO USING A SIZE-DEPENDENT FOOD CHAIN MODEL,**  
Manhattan Coll., Bronx, NY. Dept. of Environmental Engineering and Science.  
R. V. Thomann.  
In: Perspectives in Lake Ecosystem Modeling, p 293-320, 1979. 11 fig, 4 tab, 38 ref.

Descriptors: \*Lake Ontario, \*Food chains, \*Mathematical models, \*Aquatic environment, \*Ecosystems, \*Mass balance, \*Water quality, \*Hazardous substances, \*Organism length, \*Simulation analysis, Equations, Systems analysis, Equations, Polychlorinated biphenyls, Compartment analysis, Continuous model, Toxicity, Biomass, Density function, Data analysis, Distribution, Dynamics, Excretion, Uptake rates.

Considered is the development of models for simulating the distribution and dynamics of toxic substances within an ecosystem. In order to incorporate both bioaccumulation of toxic substances directly from the water and subsequent transfer up the food chain, a mass balance model is constructed that introduces organism size as an additional independent variable. The model represents an ecological continuum through size dependence; classical compartment analyses are therefore a special case of the continuous model. The principal factors that influence the total toxicant concentration in various regions of the food chain include excretion and uptake rates, the rate of decrease of biomass density with organism size and the food chain transfer velocity, a parameter reflecting average predation along the food chain. The model behaves linearly with respect to external mass loading of the toxicant and hence can be used in principal to estimate the input that can be allowed without exceeding given levels in various regions of trophic space. The analysis of some PCB data from Lake Ontario is used as an illustration of the theory. The introduction of organism size as an independent variable in the mass balance of a toxicant provides a generalized analysis framework; this permits the integrated use of diverse laboratory experiments on uptake and excretion as well as an interpretive framework for field data of toxicant concentrations. (See also W80-00204) (Bell-Graf-Cornell)  
W80-00216

**VIRUS CONSIDERATION IN LAND DISPOSAL OF SEWAGE EFFLUENTS AND SLUDGE,**  
Epidemiology Research Center, Tampa, FL. Dept. of Health and Rehabilitative Services.  
F. M. Wellings, A. L. Lewis, C. W. Mountain, and L. M. Stark.  
Florida Scientist, Vol. 38, No. 4, p 202-207, 1975. 1 fig, 2 tab, 11 ref.

Descriptors: \*Viruses, \*Sewage effluents, \*Sewage sludge, \*Public health, Sludge, Sewage disposal, Disposal, Soil, Soil contamination, Potable water, Water pollution, Water quality.

Laboratory and field experiments prove that virus does percolate through soils, is adsorbed by the soil, can be described, moves with the subsurface waters, and can survive in the soil for at least 28 days. This documentation of virus survival and movement in the terrestrial environment warrants concern over the threat to public health posed by disposal of man's biological wastes. (Bollinger-Mass)  
W80-00306

**ORGANOCHLORINE INSECTICIDES AND PCB IN SURFICIAL SEDIMENTS (1968) AND SEDIMENT CORES (1976) FROM LAKE ONTARIO,**  
Ontario, Ministry of Agriculture and Food, Guelph, Pesticide Residue Lab.  
R. Frank, R. L. Thomas, M. Holdrinet, A. L. W. Kemp, and H. E. Braun.  
Journal of Great Lakes Research, Vol. 5, No. 1, p

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

18-27, 1979. 5 fig, 6 tab, 19 ref.

Descriptors: \*Insecticides, \*Polychlorinated biphenyls, \*Lake Ontario, \*Sediments, Sampling, Pollutants, Chemical analysis, Pesticides, Dieldrin, DDT, DDE, DDD, Chlorinated hydrocarbon pesticides, Bottom sediments, Lakes, Lake sediments, Sedimentation, Sedimentation rates, Sedimentology.

Surficial sediments were collected in 1968 and core sediments in 1976 from Lake Ontario. These were analyzed for organochlorine insecticides and PCB. Residues of organochlorine compounds were higher in the 3 Ontario depositional basins than in sediment in the non-depositional zones. PCB was present at the highest concentration, with mean levels of 57 ppb for the whole lake. Residues of PCB in the three basins exhibited only minimal differences. Sigma DDT was the second most frequently found contaminant. Both parent DDT and its 2 metabolites were present in sediment, giving a mean residue of 42.8 ppb for the whole lake. Differences in residues for the 3 basins were again minimal. DDT was present in sediments estimated to be deposited between 1958 and 1976. HEOD was present in only 40% of sediments, and the mean residue for the whole lake was 0.6 ppb. The Niagara basin contained mean residues (1.4 ppm) of HEOD much above the other basins. Chlordane was virtually absent from the lake in the sediments collected in 1968 but appeared in cores between 1964-1976. Endosulfan appeared in lake sediments as a spill of deck cargo at a location in the Niagara basin. This spill dispersed with the current down the south shore to deposit in the Rochester basin. (Sims-ISWS) W80-00341

EFFECTS OF ACIDIC PRECIPITATION ON PRECAMBRIAN FRESHWATERS IN SOUTHERN ONTARIO, Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section. W. A. Scheider, D. S. Jeffries, and P. J. Dillon. Journal of Great Lakes Research, Vol. 5, No. 1, p 45-51, 1979. 5 fig, 4 tab, 18 ref.

Descriptors: \*Chemistry of precipitation, \*Acidic water, \*Water chemistry, \*Canada, Precipitation (Atmospheric), Rainfall, Lakes, Streams, Sampling, Chemical analysis, Hydrogen ion concentration, Alkalinity, Acidity, Acids, Water pollution, Water pollution control, Mercury, Fish, Pollutants, Meteorology, Acidic rainfall.

The pH of precipitation falling on the Precambrian Shield of south-central Ontario averages 4.0-4.2, as low or lower than that of precipitation in areas of the world with recognized problems of acidification of freshwaters. The area is underlain by non-calcareous bedrock of low solubility with a thin glacial overburden, and consequently many lakes have low buffering capacities. Some lakes and streams have had their pH's reduced by acidic precipitation, especially during spring runoff and after storm events. The pH of some lakes is 5.0-5.5, a level at which the reproductive success of certain fish species is impaired. Walleye of the same length show higher Hg levels in low alkalinity (less than 300 micro eq/L) waters compared to higher alkalinity waters. (Sims-ISWS) W80-00344

SURFACE LOADING FROM POLLUTANTS IN PRECIPITATION IN SOUTHERN ONTARIO: SOME CLIMATIC AND STATISTICAL ASPECTS, Windsor Univ. (Ontario). Dept. of Geography. M. Sanderson, and P. D. LaValle. Journal of Great Lakes Research, Vol. 5, No. 1, p 52-60, 1979. 4 fig, 5 tab, 19 ref.

Descriptors: \*Chemistry of precipitation, \*Pollutants, \*Water pollution sources, \*Surface waters, \*Canada, Sampling, Chemicals, Chemical analysis, Precipitation (Atmospheric), Sulphates, Nitrogen, Phosphates, Chlorides, Calcium, Sodium, Potassium, Magnesium, Heavy metals, Polychlorinated biphenyls, Path of pollutants, Water pollution.

Monthly samples of precipitation during the period June 1975 to June 1977 from bulk type precipitation gauges located in 6 watersheds in southern Ontario were analyzed for sulphate, nitrogen, phosphate, chloride, calcium, sodium, potassium, magnesium, heavy metals, and PCBs. The relationship between the surface loading of the pollutant and the amount of precipitation during the observation period was investigated, and a significant relationship at the 0.05 level was found for all pollutants except sodium. The loadings in g/ha/d were tested statistically for spatial and temporal variability. All parameter loadings showed a downward trend over time, and it was suggested that this is due to decreased precipitation during the second year of observation. No significant seasonal differences were found in the surface loadings. Analysis of variance tests indicated that at the 0.05 level of significance, no significant differences in monthly loadings were observed for all parameters except calcium and magnesium, although some locations were very near and others hundreds of kilometers distant from the major sources of industrial pollutants. (Sims-ISWS) W80-00345

ACIDIFICATION OF HEADWATER STREAMS IN THE NEW JERSEY PINE BARRENS, Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture. For primary bibliographic entry see Field 5B. W80-00354

DENITRIFICATION IN A SALT MARSH ECOSYSTEM, Marine Biological Lab., Woods Hole, MA. Boston Univ. Marine Program. For primary bibliographic entry see Field 2L. W80-00355

TOXICITY OF 4-CHLORO-O-CRESOL TO FISH. LIGHT MICROSCOPY AND CHEMICAL ANALYSIS OF THE TISSUE, Jyväskylä Univ. (Finland). Dept. of Chemistry. M. L. Hattula, H. Reunanen, V-M. Wasenius, R. Krees, and A. U. Arstila. Bulletin of Environmental Contamination and Toxicology, Vol. 22, p 508-511, 1979. 1 tab, 6 ref.

Descriptors: \*Brown trout, \*Pesticide residues, \*Pesticide toxicity, Chlorinated hydrocarbon pesticides, Chromatography, Chemical analysis, Fish, Physiology, Herbicides, Path of pollutants, Lethal limit, Mortality, \*MCPA, \*Bioaccumulation, \*Tissue analysis.

This study is part of a series in which the toxicity of the metabolites of MCPA (4-Chloro-2-phenoxyacetic acid) is studied in rats and fish. In the present work the acute and subchronic toxicity was studied in sea trout (Salmo trutta). In the first subchronic experiment (20 fish/aquarium, cresol concentration 0.5 and 1.0 ppm) the fish were killed after four weeks and after three weeks in the second experiment (cresol concentration 0.5, 1.0 and 1.5 ppm). For the pathological analysis the samples were taken from liver, kidney and gills from 10 specimens. All fish from water containing 0.5 ppm 4-chloro-o-cresol were histologically normal but some specimens from water containing 1.0 ppm cresol had histopathological changes. The fish from water containing 1.5 ppm cresol some changes were observed in kidneys and gills. The concentrations of 4-chloro-o-cresol in the wet tissue of the fish in the subchronic experiments are presented. (Deal-EIS) W80-00391

THE UPTAKE OF 226RA BY PLANKTONIC ALGAE UNDER CONDITIONS OF CONTINUOUS CULTIVATION, Institut Hygieny a Epidemiologie, Prague (Czechoslovakia). Dept. of General Public Hygiene. B. Havlik, and J. Hanusova. Acta hydrochimica et hydrobiologica, Vol. 7, No. 2, p 145-152, 1979. 1 fig, 6 tab, 15 ref.

Descriptors: \*Radium radioisotopes, \*Absorption, \*Phytoplankton, Radiochemical analysis, Tracers,

Scenedesmus, Plant physiology, Cyanophyta, Chlorophyta, Path of pollutants, \*Bioaccumulation, \*Tissue analysis, \*Coelastrium, \*Microcystis.

The radium accumulation in Coelastrium cambricum, Scenedesmus obliquus and Microcystis pulvereus was studied under conditions of continuous cultivation at constant levels of radium in the cultivation medium. The algae were exposed to the concentrations of 30, 300 and 3000 Bq/1226Ra in the medium for a period of 14 days. It was found that radium started to accumulate immediately after its addition to the culture just as in the stationary type of cultivation. In the continuous cultivation, however, its content decreased with the length of exposure. This is due to the decreasing part of radium adsorbed on the cell surface. While in green algae the portion of radium incorporated into cells increased with the length of exposure, in blue-green algae up to 90% of radium was bound to the surface or gelatinous capsules of the cells throughout the experiment. With the three phytoplankton species used, the highest accumulation of radium (nonwashable part) was recorded in Coelastrium cambricum. A dependence of the radium accumulation on its content in the medium was observed in the species Scenedesmus obliquus. (Deal-EIS) W80-00394

TISSUE ENZYME ACTIVITIES FOLLOWING EXPOSURE TO DIETARY MIREX IN THE CHANNEL CATFISH, ICTALURUS PUNCTATUS, Mississippi State Univ., Mississippi State. Dept. of Biological Sciences. F. M. McCorkle, J. E. Chambers, and J. D. Yarborough. Environmental Pollution, Vol. 13, p 195-199, 1979. 5 tab, 9 ref.

Descriptors: \*Channel catfish, \*Enzymes, \*Pesticide toxicity, Chlorinated hydrocarbon pesticides, Fish physiology, Animal metabolism, Chemical analysis, Path of pollutants, Pesticide kinetics, Proteins, \*Mirex, \*Tissue analysis.

Young channel catfish (Ictalurus punctatus) were exposed to 1, 100, 200 and 400 ppm dietary mirex. Specific activities of lactic dehydrogenase, malic dehydrogenase, glutamate pyruvate transaminase and glutamate oxaloacetate transaminase were determined in gill, brain, liver and muscle at one, two, three and four weeks. Few changes in enzyme specific activities were found which were attributable to mirex exposure. It appears that mirex, even at high dietary exposure levels, is relatively innocuous to these enzyme activities. (Deal-EIS) W80-00395

ACCUMULATION OF CADMIUM BY DUNALIELLA TERTIOLECTA BUTCHER, Queen Mary Coll., London (England). Dept. of Zoology and Comparative Physiology. J. R. Jennings, and P. S. Rainbow. Journal of Plankton Research, Vol. 1, No. 1, p 67-74, 1979. 2 fig, 2 tab, 20 ref.

Descriptors: \*Cadmium, \*Absorption, \*Phytoplankton, \*Chlorophyta, Food chains, Marine algae, Cytological studies, Water chemistry, Chemical analysis, Primary productivity, Trophic level, Heavy metals, Path of pollutants, \*Bioaccumulation, \*Dunaliella.

Cultures of Dunaliella tertiolecta were exposed to five concentrations of cadmium in solution (0.1, 0.5, 1, 5 and 10 ppm). The accumulation of cadmium by the algae was found to have two phases, an initial rapid uptake followed by a stabilisation of the cellular cadmium levels. D. tertiolecta concentrated cadmium from solution (conc. factor approx. 1350) at exposures up to 1 ppm Cd but exposure to the higher concentrations caused no further increase in the accumulated cadmium concentration of the algae which reached a maximum at about 1.5 µg Cd mg/1 Dunaliella. (Deal-EIS) W80-00398

THE CONTRIBUTION OF AMMONIA EXCRETED BY ZOOPLANKTON TO PHYTO-

## Sources Of Pollution—Group 5B

## PLANKTON PRODUCTION IN NARRAGANSETT BAY,

Rhode Island Univ., Kingston. Graduate School of Oceanography.  
G. A. Vargo.

Journal of Plankton Research, Vol. 1, No. 1, p 75-84, 1979. 4 fig, 3 tab, 28 ref.

Descriptors: \*Ammonia, \*Zooplankton, \*Primary productivity, Seasonal, Diatoms, Phytoplankton, Aquatic populations, Nitrogen, Dominant organisms, Absorption, Biomass, Growth rates, Nutrients, Chesapeake Bay, \*Skeletonema.

Ammonia excreted by mixed zooplankton populations over an annual (1972-1973) cycle in Narragansett Bay varied from 0.04 to 3.21 micrograms at NH<sub>3</sub>-N/dry wt/day, exclusive to two exceptional rates measured one year apart: 11.74 and 18.39 micrograms at NH<sub>3</sub>-N mg/dry wt/day. Gross phytoplankton production integrated over the year (1972-1973) averaged 151 mg C/cubic meter/day for an 8 m water column; peaks of 332 and 905 mg C cubic meter/day occurred during the winter-spring and summer blooms, respectively. Excreted ammonia, integrated seasonally and annually, contributed only 0.2% and 4.9% of the nitrogen required for observed gross production during the winter-spring and summer blooms, respectively, and 4.4% annually. However, excreted ammonia may be an important source of the nitrogen required by *Skeletonema* costatum, the dominant diatom in Narragansett Bay, during the post-bloom period when 186% of the nitrogen required for its net production was met by ammonia excretion. A combination of zooplankton ammonia excretion and benthic ammonia flux contributed 22% of the nitrogen required for the annual gross production (440 g/square meter) while 51% of the nitrogen required for the net production of *Skeletonema* was accounted for by regenerated nitrogen. (Deal-EIS)  
W80-00399

## RESPONSE OF LAKE PHYTOPLANKTON COMMUNITIES TO IN SITU MANIPULATIONS OF LIGHT INTENSITY AND COLOUR,

Ottawa Univ. (Ontario). Dept. of Biology.  
D. Wall, and F. Briand.

Journal of Plankton Research, Vol. 1, No. 1, p 103-112, 1979. 3 fig, 1 tab, 38 ref.

Descriptors: \*Phytoplankton, \*Light intensity, Light penetration, Diatoms, Chlorophyll, Dinoflagellates, Habitats, Depth, Stratification, Cyanophyta, Anabaena, Scenedesmus, Chlamydomonas, Competition, Chrysophyta.

Phytoplankton preferences for light intensity and colour were determined in field experiments using coloured plexiglass cubes suspended at different depths in Heney Lake, Quebec. Diatoms and green algae favoured intensities greater than 1% I sub 0 (surface irradiance) contrary to dinoflagellates and other flagellates that preferred lower intensity. Red radiation usually increased the relative proportion of blue-greens, diatoms and green algae, whereas it reduced that of dinoflagellates. The authors propose that differential utilization of the light gradient allows certain phytoplankton taxa to partition the water column, thereby reducing potential competition. This is supported by the general agreement between the authors' findings and the known depth distribution of algae in lakes. (Deal-EIS)  
W80-00400

## 5B. Sources Of Pollution

## ADSORPTION AND ACCUMULATION OF PESTICIDES RESIDUES AND CHLORINATED BIPHENYLS IN BOTH WILD AQUATIC VEGETATION AND RICE IN THE CAMARGUE REGION, (IN FRENCH),

Centre National de la Recherche Scientifique, Arles (France). Centre Ecologie Camargue.  
A. Vaquer.

Oecologia Plantarum, Vol. 8, No. 4, p 353-365, 1973. 2 fig, 5 tab, 23 ref. (English summary).

Descriptors: \*Marsh plants, \*Pesticide residues, Wetlands, Pollutants, Bioindicators, Algae, Pesticide drift, Chlorinated hydrocarbon pesticides, DDT, Crops, Rice, Aquatic plants, Cattails, Ponds, Weeds, Pesticides.

The residues from certain chlorinated chemicals present in relatively small quantities in the various aquatic habitats in the Camargue (Rhône delta) have been investigated in some aquatic and semi-aquatic plant species, including rice. These plants absorb and concentrate the products (alpha and gamma BHC, DDT, and PCB's), with accumulated levels compared with water varying between 16 and 20,000 (dry matter) according to the species. The products absorbed are not spread homogeneously throughout the plant but are generally stored at higher levels in the leaves than in the roots and at the base of the stem. Likewise the concentrations in the fruit are higher than in the plant itself. Specific differences in concentrations are due to different stages of development, to the various absorbing qualities and to the metabolic activity, in particular the degradation. Because of their high accumulating capacity, algae seem to be good indicators of the degree of water pollution. (Steiner-Mass)  
W80-00020

## DETERMINATION OF HYDRODYNAMIC DISPERSION COEFFICIENTS USING 'IN-VERFC'

Punjab Agricultural Univ., Ludhiana (India). Coll. of Agricultural Engineering.

P. Basak, and V. V. N. Murty.  
Journal of Hydrology, Vol. 41, No. 1/2, p 43-48, April 1979. 1 fig, 2 tab, 8 ref.

Descriptors: \*Dispersion, \*Analytical techniques, \*Methodology, Laboratory tests, Solutes, Porous media, Mathematics, \*Hydrodynamic dispersion coefficient, Breakthrough curve, Concentration, Solute transport.

For the determination of the value of the hydrodynamic dispersion coefficient in one-dimensional transport problems, explicit analytical expressions were obtained through the application of the 'in-verse' function. These expressions provide a method for quick and exact determination of the hydrodynamic dispersion coefficients with the data obtained at an arbitrary experimental point. The method thus avoids the need of obtaining the entire breakthrough curve. The validity of the procedure was established by comparing the results with those obtained from the laboratory experiments. (Singh-ISWS)  
W80-00073

## DEPRESSION OF PH IN LAKES AND STREAMS IN CENTRAL ONTARIO DURING SNOWMELT,

Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.  
For primary bibliographic entry see Field 2H.  
W80-00076

## TRITIUM AND OXYGEN PROFILES IN THE EASTERN MEDITERRANEAN,

Laboratorio di Geologia Nucleare, Pisa (Italy). G. Cortecchi, P. Noto, and B. Tonarelli.  
Tellus, Vol. 31, No. 2, p 179-183, April 1979. 3 fig, 8 ref.

Descriptors: \*Water quality, \*Tritium, \*Surveys, On-site investigations, Dissolved oxygen, Salinity, Analytical techniques, Profiles, Foreign research, On-site data collections, Water circulation, \*Mediterranean Sea, \*Ionian Sea, \*Sea of Crete, \*Levantine Basin, \*Straits of Sicily.

The tritium and oxygen concentration profiles reported were made in February and March 1974 and referred to the Straits of Sicily, the Ionian Sea, the Sea of Crete, and the Levantine Basin. In the stations southeast of Rhodes and north of Crete, the most saline waters have the highest tritium concentrations, i.e., 10.5 + or - 0.5 T.U. and 14 T.U., respectively. In the Ionian Sea and the Straits of Sicily, on the contrary, the tritium maxi-

mum lies above the salinity maximum, with values from 12 to 19 T.U. The core of the Levantine Intermediate Water shows the same tritium concentration (about 10 T.U.) from the Levantine source regions as far as the central Ionian, suggesting a fairly high westward flowrate. (Humphreys-ISWS)  
W80-00078

## COMPARISON OF FINITE ELEMENT AND FINITE DIFFERENCE METHODS IN THERMAL DISCHARGE INVESTIGATIONS,

McGill Univ., Montreal (Quebec).  
L. D. Spragg.

Advances in Water Resources, Vol. 2, No. 2, p 91-95, June 1979. 6 fig, 2 tab, 3 ref.

Descriptors: \*Analytical techniques, \*Methodology, \*Thermal pollution, \*Powerplants, Circulation, Water circulation, Reservoirs, Model studies, Mathematical models, Flow, Temperature, Water temperature, Cooling water, Finite element analysis, Finite difference analysis.

Ultimately, the objective of scientific research into numerical methods must be to provide workers in the field with reliable, credible tools which can be used to analyze complex problems. In the field of water resources, there is the further need to be able to assess potential environmental impacts before irreversible modifications are made to existing water systems. In addition, the analysis methodology must be credible, economical, and achievable in a reasonable period of time. In this study, the use of numerical simulation models for analyzing the impact of a proposed thermal-electric power plant on the proposed cooling reservoir was investigated. The underlying objective was to provide an estimate of the thermal regime and subsequent evaporation for a coal-fired power plant with a potential for producing 1200 MW. However, the secondary objective was to determine whether existing finite element models or existing finite difference models could be used more effectively in meeting the stringent time frame imposed on completion of the study. A comparison of the results indicated that the very simple finite element model used for this study produces information which is as good as the more sophisticated finite difference model. The velocity fields produced by the two models were nearly identical, even though two totally different approaches were used. The predicted excess temperatures for the reservoir were, in general, very close. There was some difference in the temperatures calculated for the regions away from the inlet, but this was probably due to the fact that the finite difference model had not achieved a steady state condition. (Sims-ISWS)  
W80-00082

## POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE PESTICIDES IN GREAT LAKES PRECIPITATION,

Canada Centre for Inland Waters, Burlington (Ontario).  
For primary bibliographic entry see Field 5A.  
W80-00086

## A COMPARISON OF FLUORESCIN DYE AND ANTIBIOTIC-RESISTANT ESCHERICHIA COLI AS INDICATORS OF POLLUTION IN GROUNDWATER,

Oregon State Univ., Corvallis. Dept. of Microbiology.  
For primary bibliographic entry see Field 2G.  
W80-00145

## A CHEMICAL ASSESSMENT OF THE PRESENT LEVELS AND SOURCES OF HYDROCARBON POLLUTANTS IN THE GEORGES BANK REGION,

Energy Resources Co., Inc., Cambridge, MA.  
P. D. Boehm, W. G. Steinhauer, D. L. Fiest, and N. Mosesman.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 333-341, 1979. 6 fig, 2 tab, 33 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

**Descriptors:** \*Oil spills, \*Water pollution sources, \*Water pollution effects, Benthos, Shellfish, Environmental effects, \*Outer Continental Shelf, \*Georges Bank, Gulf of Maine, Hydrocarbons, Argo Merchant oil spill.

Analysis of five suites of samples covering 40 stations in the region of Georges Bank Nantucket Shoals, and the lower Gulf of Maine illustrates the ubiquity of anthropogenic hydrocarbons throughout this highly productive and heavily fished area. Petroleum compounds from a recent major oil spill (Argo Merchant) and chronic inputs from ballast washings and normal shipping traffic were evident in the water column's dissolved and particulate hydrocarbon fractions. Surface sediments contained both anthropogenic and biogenic hydrocarbons. Analyses of whole benthic invertebrates revealed sporadic but sizeable inputs of petroleum hydrocarbons to the benthic environment. These were assimilated by such edible species as sea scallops and ocean quahogs, commonly harvested in the region. (Sinha-OEIS)  
W80-00157

**DISTRIBUTION OF TAR AND RELATIONSHIP TO CHANGES IN INTERTIDAL ORGANISMS ON SANDY BEACHES IN SOUTHERN CALIFORNIA.**  
University of Southern California, Los Angeles. Inst. for Marine and Coastal Studies.  
D. Straghan.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 591-601, 1979. 11 fig. 2 tab, 27 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil pollution, \*Beaches, \*Sediments, \*Environmental effects, California, Intertidal areas, Water pollution sources, Water pollution effects, Seepage, \*Outer Continental Shelf, \*Tar, Natural seepage.

Surveys on sandy beaches for 10 years following the Santa Barbara oil spill (1969-1978) revealed that large amounts of tar are frequently found at sites adjacent to natural oil seep areas. Tar is intermittently found on most other open coast southern California beaches. This is in contrast to few records of tar on over 40 surveys at sites in the area just north of Point Conception. The sources of tar is both difficult and costly to determine. However, available information suggests that with the exception of major oil spills, most tar on the beaches originates from natural oil seeps. On the open coast beaches, the residence time of this tar appears to be short (generally days and perhaps weeks) but after exceptional storms such as those in the winters of 1969 and 1978, tar could be buried for longer periods. In most instances deeply buried tar would be removed by the approximately annual cut and fill cycle. At all sites, natural environmental variables such as sediment grain size, had a greater impact on the distribution and abundance of species than tar. Within this framework, changes in populations at Cat Harbor following contamination by wet sticky tar in early spring 1976, appear to be a response to this tar. Conservative estimates currently suggest a two-year recovery period. This may be revised after further research. (Sinha-OEIS)  
W80-00173

**MONITORING OF SUBSURFACE INJECTION OF WASTES, FLORIDA.**  
Geological Survey, Tallahassee, FL. Water Resources Div.  
J. Vecchioli.  
Ground Water, Vol. 17, No. 3, p 244-249, May-June 1979. 2 fig, 1 tab, 5 ref.

**Descriptors:** \*Injection wells, \*Underground waste disposal, \*Monitoring, \*Observation wells, \*Path of pollutants, Florida, Aquifer management, Data collections, Aquifer characteristics, Groundwater movement, Evaluation, \*Pensacola (FL).

Injection of waste liquids into Florida's subsurface is physically feasible in many places but should be accompanied by monitoring of the waste-receiving

aquifer system in addition to the injection facility. Monitoring of the interaction of factors including hydrogeologic conditions, well construction, waste volumes and characteristics, and potable-water resources is desirable to assure that fresh-water resources are not being adversely affected. An effective aquifer-system monitoring program includes on-site wells located close to an injection well and open to the next-higher permeable stratum, satellite wells located hundreds to several thousands of feet from an injection well and open to the receiving aquifer, and regional wells located miles from individual injection wells and open to the receiving aquifer. An extensive aquifer-system monitoring program associated with two waste-injection facilities near Pensacola, Florida, has provided data which have aided hydrologists to understand the aquifer system's response to the injection and, accordingly, to evaluate the potential for affecting the area's fresh-water resources. (Woodard-USGS)  
W80-00222

**THE PREVALENCE OF SUBSURFACE MIGRATION OF HAZARDOUS CHEMICAL SUBSTANCES AT SELECTED INDUSTRIAL WASTE LAND DISPOSAL SITES.**  
Geraghty and Miller, Inc., Port Washington, NY.  
D. Miller, O. Braids, and W. Walker.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 103, Price codes: A23 in paper copy, A01 in microfiche. Report EPA-SW-634, 1977. 509 p, 3 fig, 4 tab, 18 ref, 4 append.

**Descriptors:** \*Industrial wastes, \*Landfills, \*Leachate, \*Migration, \*Hazards, Heavy metals, Arsenic compounds, Organic compounds, Lead, Chromium, Standards, Water pollution sources.

The prevalence of subsurface migration of hazardous chemical constituents was investigated at 50 land disposal sites of industrial wastes. Monitoring wells were sampled at the sites which included landfills, lagoons, and a combination of the two. At forty-three of the sites migration of heavy metals, cyanide, arsenic, selenium or organic substances was determined. Organic contaminants were present at 40 of the 50 sites and migration was confirmed at 27 sites. Heavy metals were present at 49 sites and were confirmed to have migrated at 40 sites. Selenium, arsenic, and/or cyanide were present at 37 sites and were confirmed to have migrated at 30 sites. Hazardous inorganic constituents in amounts exceeding the EPA drinking water standards were found in 26 of the monitoring wells. Selenium was the most frequent substance found to exceed limits, followed by arsenic, chromium, and lead. (Small-FRC)  
W80-00248

**HEAVY METALS AND WASTEWATER REUSE.**  
Arizona State Univ., Tempe. Dept. of Engineering.  
T. E. Higgins.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 101-109, 6 tab, 9 fig, 25 ref.

**Descriptors:** \*Heavy metals, \*Chemical wastes, \*Water pollution effects, \*Chemical properties, \*Water reuse, Water quality, Environmental effects, Chemical analysis, Waste water treatment, Groundwater recharge, Mathematical models.

The increasing reuse of wastewaters in the arid western states is analyzed in an effort to establish the long term effects of the application of heavy metal containing wastewaters to the land. Based upon a review of the literature and of solubility chemistry the following conclusions are made concerning the fate of heavy metals when wastewaters are applied to the land for irrigation and groundwater recharge: (1) an appreciable amount of heavy metals is removed in conventional wastewater treatment, (2) additional removal of heavy metals is effected when advanced wastewater treatment processes (chemical, coagulation, sediments and filtration) are used, (3) initial

removal of heavy metals in wastewaters applied to land is probably by chemical precipitation and filtration, (4) additional removal of heavy metals is accomplished by absorption of soil particles; fine soils are better absorption media than coarse soils, and (5) a mathematical model could be prepared using equilibria solubility and absorption chemistry, groundwater flow theory and mass balances to predict the long-term fate of heavy metals in wastewater applied to the land. (Tickes-Arizona)  
W80-00282

**WATER QUALITY OF RUNOFF FROM SURFACE MINED LANDS IN NORTHERN ARIZONA.**  
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.  
J. Kempf, L. Leonhart, M. Fogel, and L. Duckstein.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 146-156, 3 tab, 2 fig, 18 ref.

**Descriptors:** \*Water quality, \*Runoff, \*Ponds, \*Coal mines, \*Environmental effects, \*Strip mine wastes, \*Water pollution sources, Surface runoff, Mine water, Pollutant identification, Salinity, Heavy metals, Fluorides, Sodium, Land reclamation, Planning, Watershed management, Computer models, Systems analysis, Model studies, Arizona, Black Mesa, Arizona.

Surface mining of coal in the western U.S. can cause problems of increased salinity and heavy metal contamination in runoff along with a lack of enough rainfall to sustain plant growth for reclamation. To facilitate the planning of reclamation efforts in such areas results are described of a water quality sampling experiment on the ponds and runoff at the University of Arizona Experimental Watershed on Black Mesa in northern Arizona. A systems theoretic framework is employed to model the watershed and the results of a computer simulation based on this model is used to indicate that salinity buildup could be expected over time, given a minimal change in watershed configuration, with possible development of fluoride contamination being of particular concern. Water quality tests of the pond water and runoff on Black Mesa indicated that the water is within Federal standards for drinking and irrigation, except for sodium and fluoride. It is suggested that if it is economically desirable, the collection of more data on the ponds could be used to develop a simulation model of pond subsystems along the lines of the methodology outlined in this analysis. (Tickes-Arizona)  
W80-00288

**SURFACE LOADING FROM POLLUTANTS IN PRECIPITATION IN SOUTHERN ONTARIO: SOME CLIMATIC AND STATISTICAL ASPECTS.**  
Windsor Univ. (Ontario). Dept. of Geography.  
For primary bibliographic entry see Field 5A.  
W80-00345

**BOD/TOC CORRELATIONS AND THEIR APPLICATION TO WATER QUALITY EVALUATION.**  
Waterloo Univ. Research Inst. (Ontario).  
For primary bibliographic entry see Field 5D.  
W80-00353

**ACIDIFICATION OF HEADWATER STREAMS IN THE NEW JERSEY PINE BARRENS.**  
Pennsylvania Univ., Philadelphia. Dept. of Landscape Architecture.  
A. H. Johnson.  
Journal of Environmental Quality, Vol. 8, No. 3, p 383-386, July-September 1979. 3 fig, 4 tab, 11 ref.

**Descriptors:** \*Acidity, \*Streams, \*New Jersey, Hydrogen ion concentration, Chemicals, Chemical analysis, Sampling, Runoff, Rainfall, Precipitation (Atmospheric), Pollutants, Water pol-

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Effects Of Pollution—Group 5C

lution, Acids, Path of pollutants, Acid precipitation.

Sixteen years of stream pH data indicate acidification of two relatively undisturbed headwater streams of the New Jersey Pine Barrens. Average yearly stream pH decreased approximately 0.2 to 0.5 units in two small streams that have long-term records. Hydronium ion concentration was correlated with  $\text{SO}_4$  in the two headwater streams in approximately a 1:1 ratio by equivalents, suggesting that  $\text{H}_2\text{SO}_4$  is an important source of the acidity. A decrease in precipitation pH over the period was suggested in the literature and may be responsible for the decreasing stream pH. (Sims-ISWS) W80-00354

**DENITRIFICATION IN A SALT MARSH ECOSYSTEM**, Marine Biological Lab., Woods Hole, MA. Boston Univ. Marine Program. For primary bibliographic entry see Field 2L. W80-00355

**CONTRIBUTION OF URBAN RUNOFF TO HYDROCARBON POLLUTION**, Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Sciences. J. V. Hunter, T. Sabatino, R. Gomperts, and M. J. Mackenzie. Journal of the Water Pollution Control Federation, Vol. 51, No. 8, p 2129-2138, 1979. 6 fig, 7 tab, 22 ref.

Descriptors: \*Urban runoff, \*Organic compounds, \*Water pollution sources, \*Pennsylvania, On-site investigations, Data collections, Water pollution, Storm water, Chemical oxygen demand, Water sampling, Analytical techniques, Laboratory tests, Water quality, Aromatic compounds, Suspended solids, Precipitation (Atmospheric), Computer models, Hydrographs, Oil pollution, Oil wastes, Hydrograph-pollutograph, Crankcase oil.

Runoff from an urban, northern Philadelphia, Pennsylvania, area was found to contain on the average 3.69 mg/l total hydrocarbons. This concentration indicates a loading of 25.7 kg/ha/y from urban areas on the lower Delaware Estuary. Of the total hydrocarbons, 69.6% were aliphatic and 30.4% were aromatic. In addition, 86.4% were associated with the particulate materials present and only 13.6% with the soluble constituents. However, as the runoff increased, the fraction of hydrocarbons associated with the particulates also increased. No relationship was found between load and the time since prior rainfall, but a relationship was observed between runoff and load. Retention time and peak area patterns by gas chromatography indicated that crankcase oil may be the primary source of the petroleum hydrocarbons in urban runoff. (Humphreys-ISWS) W80-00357

**THERMAL ALTERATION OF GROUNDWATER CAUSED BY SEEPAGE FROM A COOLING LAKE**, Northern Cheyenne Research Project, Lane Deer, MT. C. B. Anderson, and M. P. Anderson. Water Resources Research, Vol. 15, No. 3, p 595-602, June 1979. 8 fig, 1 tab, 18 ref. EPA R03971020.

Descriptors: \*Cooling water, \*Groundwater, \*Seepage, \*Water temperature, Powerplants, Heated water, Infiltration, Groundwater movement, Surface waters, Rivers, Model studies, Mathematical models, On-site investigations, Temperature, Heat, Heat flow, Thermal pollution.

Groundwater temperatures in the vicinity of a 200-ha power plant cooling lake in central Wisconsin were monitored in the field for 1 year, and the response of subsurface temperatures to seasonal changes in lake and air temperatures was simulated by means of a mathematical model. The cooling lake, which has been in use since May 1975, when a 500-Mw electric generating unit began operation,

loses water to the groundwater system at a rate of 20,000 cu m/d. The zone of thermally altered groundwater is confined to a relatively small area hydraulically downgradient from the cooling lake. However, the lake is situated in a groundwater discharge area, and changes in subsurface temperatures at depths less than 6 m are believed to have affected the vegetation in the thermally altered zone. The model, which couples equations describing groundwater flow with those describing heat transport in the subsurface, was used to simulate the seasonal temperature fluctuations within 7 cross sections oriented parallel to the direction of groundwater flow away from the cooling lake. Simulated temperature patterns agreed well with field data but were very sensitive to the distribution of subsurface lithologies. Results from a predictive simulation suggested that when a second 500-Mw generating unit begins operation in 1978, groundwater temperatures will increase less than 5°C at distances greater than 15 m from the cooling lake. The results of this study suggested that the potential for significant thermal alteration of surface water bodies located in groundwater discharge areas is slight. (Sims-ISWS) W80-00358

**LAGRANGIAN AND EULERIAN MEASUREMENTS OF HORIZONTAL MIXING IN THE BALTIC**, Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde. F. Schott, and D. Quadfasel. Tellus, Vol. 31, No. 2, p 138-144, April 1979. 1 fig, 2 tab, 15 ref. ONR N000114-75-0173.

Descriptors: \*Dye dispersion, \*Diffusion, \*On-site tests, \*Oceans, Movement, Tracers, On-site investigations, Mixing, Currents (Water), Fluctuations, Analytical techniques, Mathematical models, Rhodamine, \*Baltic Sea, Diffusion coefficients, Horizontal mixing, Lagrangian measurements, Eulerian measurements.

Six dye diffusion experiments and simultaneous moored current-meter measurements with vector-averaging current meters were carried out in the Baltic surface-mixed layer on four days with different wind and surface wave conditions. These measurements were used to test the Hay-Pasquill method of calculating Lagrangian diffusion coefficients from Eulerian fluctuation measurements which has been frequently applied to meteorological but not yet to oceanographic measurements. For the fairly wide range of the experimental conditions, it was found that the Lagrangian dye diffusion coefficients and the product (overbar  $sq$  u sub E) (T sub E) of variances and integral over the autocorrelation function of the lateral Eulerian current fluctuations were significantly correlated. Due to the special circumstances of the moored current measurements, the factor relating them was not exactly the Beta of Hay-Pasquill. This factor, for the definition of the commonly used apparent diffusion coefficient, was determined as 1.4 + or - 0.4, but for diffusion coefficients more specifically related to the diffusion velocity model used in the analysis, it would be about similar to those determined in earlier meteorological work. The calculation was also done for the diffusion experiment which Kullenberg carried out in the pycnocline at about 45 m depth. There the factor was only 1/10 of that in the surface-mixed layer. This small value is due to a larger correlation time scale in the stratified part of the water column which was most likely caused by internal wave effects. (See also W78-03254) (Humphreys-ISWS) W80-00359

**TOXICITY OF 4-CHLORO-O-CRESOL TO FISH. LIGHT MICROSCOPY AND CHEMICAL ANALYSIS OF THE TISSUE**, Jyväskylä Univ. (Finland). Dept. of Chemistry. For primary bibliographic entry see Field 5A. W80-00391

**THE UPTAKE OF 226RA BY PLANKTONIC ALGAE UNDER CONDITIONS OF CONTINUOUS CULTIVATION**, Institut Hygieny a Epidemiologie, Prague

(Czechoslovakia). Dept. of General Public Hygiene. For primary bibliographic entry see Field 5A. W80-00394

**TISSUE ENZYME ACTIVITIES FOLLOWING EXPOSURE TO DIETARY MIREX IN THE CHANNEL CATFISH, ICTALURUS PUNCTATUS**, Mississippi State Univ., Mississippi State. Dept. of Biological Sciences. For primary bibliographic entry see Field 5A. W80-00395

**EFFECT OF DISTILLERY WASTE ON SOME FRESHWATER TELEOSTS-BIOCHEMICAL STUDIES**, D. A. V. Coll., Muzaffarnagar (India). Dept. of Zoology. S. R. Verma, A. K. Tyagi, and R. C. Dalela. Environmental Pollution, Vol. 13, p 225-228, 1979. 2 tab, 16 ref.

Descriptors: \*Enzymes, \*Inhibition, \*Industrial wastes, Chemical wastes, Toxicity, Freshwater fishes, Chemical analysis, Fish physiology, Animal metabolism, Phosphates, Biochemistry, Distillery wastes, \*Tissue analysis.

The effect of distillery waste on the activities of alkaline and acid phosphatases in two teleost fishes, *Ophiocephalus punctatus* and *Saccobranchius fossilis*, is reported. The waste produced a significant fall in enzyme activity (alkaline and acid phosphatases) and this was more significant in liver than in kidney in both species. Further, the increase in exposure time decreased enzyme activity significantly. (Deal-EIS) W80-00396

**ACCUMULATION OF CADMIUM BY DUNALIELLA TERTIOLETA BUTCHER**, Queen Mary Coll., London (England). Dept. of Zoology and Comparative Physiology. For primary bibliographic entry see Field 5A. W80-00398

### 5C. Effects Of Pollution

**COMPARISON OF DIURNAL FLUCTUATIONS OF DISSOLVED INORGANIC CARBON AND ALGAL PRODUCTIVITY ESTIMATES IN AN OLIGOTROPHIC AND MESOTROPHIC FRESHWATER ENVIRONMENT**, Rensselaer Polytechnic Inst., Troy, NY. P. A. Amodeo, and N. L. Clesceri. Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 201. Price codes: A03 in paper copy, A01 in microfiche. Technical Completion Report, July, 1979. 25 p, 10 fig, 37 ref. OWRT B-060-NY(1). 14-34-0001-7172.

Descriptors: \*Dissolved carbon, Particulate matter, Carbon-14 technique, Manometric technique, \*Freshwater lakes.

Investigation was made into factors influencing the daily periodicity of algal carbon incorporation. Carbon, in the form of dissolved  $\text{CO}_2$ , is proposed as a major limiting nutrient in both an oligotrophic and mesotrophic environment. A relationship between diurnal fluctuations of DIC and algal carbon uptake is demonstrated by use of carbon-14 as a radio-carbon tracer. DIC estimates were made using a manometric technique. A possible correlation of the above fluctuations with the excretion of organic matter by algae is proposed. Work was conducted at Gull Bay, Lake George, New York and Willsboro Bay, Lake Champlain, New York. W80-00002

**CONTROL OF SALT MARSH CULICOIDES AND TABANUS LARVAE IN SMALL PLOTS WITH GRANULAR ORGANOPHOSPHORUS PESTICIDES, AND THE DIRECT EFFECT ON OTHER FAUNA**, Bridgewater State Coll., MA. Department of Biol-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

ogy.  
W. J. Wall, Jr., and V. M. Marganian.  
Mosquito News, Vol. 33, No. 1, p 89-93, March, 1973. 2 tab, 4 ref.

Descriptors: \*Salt marshes, \*Organophosphorus pesticides, \*Environmental effects, Diazinon, Mosquitoes, Insecticides, Insect control, Fish, Crustaceans, Plankton, Pesticide toxicity, Ecology, Massachusetts.

Granular formulations of Dursban applied at the rate of 0.2 and 0.05 pound of technical material per acre and Diazinon applied at 0.2 pound per acre to salt marsh mud significantly reduced populations of *Callicoides furcatus* and *C. hollensis* larvae with low mortality to other organisms. Baytex and Abate applied at 0.2 and 0.3 pound per acre, respectively, resulted in poor control of *Callicoides* larvae. Some dead organisms including killifish, four-spine stickleback, prawns, tanaidacean, and fiddler crabs were found in the treated and control areas and in traps placed adjacent to these areas. Plankton taken from creeks near the treated areas were not noticeably affected by the pesticides. Granular Dursban, Abate, and Diazinon applied at the rate of 0.05, 0.4 and 0.3 pounds per acre, respectively, did not appear to control *Tabanus lineola*, and *T. nigrovittatus* larvae breeding in salt marsh sod. Diazinon at 0.3 pound per acre appeared to affect killifish, while the other pesticides in the second experiment appeared to have no effect on this species. Abate and Dursban apparently did not cause a decrease in the invertebrate fauna of the treated plots, but Diazinon did. (Howard-Mass)  
W80-00013

EFFECTS OF GROUND APPLICATIONS OF MALATHION ON SALT MARSH ENVIRONMENTS IN NORTHWESTERN FLORIDA, Environmental Research Labs., Gulf Breeze, FL. M. E. Tagatz, P. W. Borthwick, G. H. Cook, and D. L. Coppage.  
Mosquito News, Vol. 33, No. 3, p 309-315, September, 1974. 4 tab, 10 ref.

Descriptors: \*Salt marshes, \*Insecticides, \*Environmental effects, Mosquitoes, Insect control, Fish, Crustaceans, Aquatic animals, Toxicity, Persistence, Estuarine environment, Ecology, Florida.

Death due to thermal fog (420 g/ha) and ULV aerosol spray (57 g/ha) applications of malathion 95 on salt marsh environments in northwestern Florida were not observed among confined blue crabs, grass shrimp, pink shrimp, or sheepshead minnow. Brain acetylcholinesterase was not reduced in confined sheepshead minnow exposed to one or more treatments. The confined animals and a species of snail contained no measurable malathion. The chemical was not detected in sediment, but concentrations as high as 4.10 ppm were found in *Juncus* sp., trace amounts persisting as long as 14 days. Highest concentration in marsh water after fogging was 5.2 ppb. Highest concentration after ULV spraying was 0.49 ppb. For each method of application, only trace amounts persisted in marsh water as long as 1 day. (Howard-Mass)  
W80-00025

#### PROBLEMS AND PERSPECTIVES IN MEASURING THE SOCIAL COSTS OF OIL POLLUTION

National Oceanic and Atmospheric Administration, Washington, D.C.  
N. F. Meade, and R. C. Anderson.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 59-62, 1979. 11 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Oil pollution, \*Social aspects, Environmental effects, Economics, Damages, Water pollution effects, \*Outer Continental Shelf, Damage assessment, Amoco Cadiz spill, Brittany Coast.

Methods must be developed for measuring the nature and extent of oil pollution damages in economic terms.

This paper analyzes the problem of providing an economic measure of oil pollution damages from three perspectives: the accuracy of the measure, the cost of the assessment, and the acceptability of the measure in judicial and policy-making arenas. Although no measure of damages reviewed is without flaws, it is suggested that comprehensive damage assessments be performed for major spills while relatively crude indices of damage be developed for the more minor, chronic forms of oil pollution. As a case example of a major spill damage assessment, recent efforts supported by the National Oceanic and Atmospheric Administration to quantify damages from the Amoco Cadiz oil spill are reviewed. (Sinha-OEIS)  
W80-00149

#### A FISHERY-OIL SPILL INTERACTION MODEL

Rhode Island Univ., Kingston. Dept. of Ocean Engineering.

M. Reed, and M. L. Spaulding.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 63-73, 1979. 18 fig, 1 tab, 75 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Fisheries, \*Water pollution effects, Models, Environmental effects, \*Outer Continental Shelf, Georges Bank.

An oil spill behavior and fates model (see paper by P. C. Cornillon et al. elsewhere in this volume) has been coupled to a fisheries model to produce dynamic simulations of the interactive effects between an oil spill and the cod fishery on Georges Bank, with impacts being projected into the commercial catch. Four trial cases are documented: spills occurring in December and April, with and without chemical treatment. Several systems problems are discussed, along with present and anticipated efforts to bring the set of models from its current preliminary state to one in which useful inferences may be drawn. (Sinha-OEIS)  
W80-00150

#### CHEMICAL CHARACTERIZATION OF MOUSSE AND SELECTED ENVIRONMENTAL SAMPLES FROM THE AMOCO CADIZ OIL SPILL

New Orleans Univ., LA. Center for Bio-organic Studies.

E. B. Overton, J. R. Patel, and J. L. Laseter.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 169-175, 1979. 5 fig, 2 tab, 14 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Environmental effects, \*Water pollution effects, Biota, Aromatic compounds, Sediments, Chemical analysis, \*Outer Continental Shelf, Amoco Cadiz oil spill, Mousse, Photo-oxidation, Brittany.

Mousse, biota, soil, sediment and reference mousse (collected immediately adjacent to the wreck) samples were collected during and immediately after the Amoco Cadiz oil spill. A medium Arabian crude oil was used as a nonweathered control sample. The extracts were fractionated by liquid/solid chromatography and analyzed by high resolution gas chromatography and GC-MS techniques (mass spectrometry). GC-MS analysis had identified most of the major components in the 40% benzene in N-hexane fractions of the sampled. Relative concentrations of selected aromatic components in the various samples were compared using a unique three-dimensional plotting format. The presence of oxidation products from the dibenzothiophenes were characterized in methanol fractions of actual environmental samples. Laboratory experiments conducted under simulated environmental conditions suggest that these oxidized products may arise by photochemical transformations. Products were identified by GC and GC-MS techniques and representative mass spectra are included. (Sinha-OEIS)  
W80-00151

#### ECOPHYSIOLOGICAL EFFECTS OF OIL SPILLS FROM AMOCO CADIZ ON PELAGIC COMMUNITIES—PRELIMINARY RESULTS

Centre Oceanologique de Bretagne, Brest (France).

J. F. Samain, J. Moal, J. Y. Daniel, J. Boucher, and J. Lefevre.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 175-185, 1979. 10 fig, 7 tab, 8 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Water pollution effects, \*Ecosystems, \*Zooplankton, Biomass, Estuaries, Enzymes, Physiology, \*Outer Continental Shelf, Amoco Cadiz spill, *Artemia salina*, Brittany.

First results on distribution and changes of biomass (dry weight and total soluble proteins), physiology (amylase, trypsin) and faunal compositions of zooplankton are reported for the two months following the Amoco Cadiz spill on the northern Brittany coast. A shortage of biomass in the Aber area is attributed to hydrocarbons. The low level of the mean value of biomass on the north coasts, and the peculiarities at the estuarine station on Lannion Bay and the Trieux area are reported and discussed. (Sinha-OEIS)  
W80-00152

#### OCCURRENCE OF OIL IN OFFSHORE BOTTOM SEDIMENTS AT THE AMOCO CADIZ OIL SPILL SITE

Centre Oceanologique de Bretagne, Brest (France).

L. D'Ozouville, M. O. Hayes, E. R. Gundlach, W. J. Sexton, and J. Michel.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 187-192, 1979. 6 fig, 12 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Bottom sediments, \*Oil pollution, Water pollution effects, Environmental effects, \*Outer Continental Shelf, Amoco Cadiz Oil spill, Brittany.

A diving survey was undertaken during August 1978 to ascertain the vertical and horizontal distribution of oil incorporated into bottom sediments of the bays of Morlaix and Lannion within the Amoco Cadiz spill site of Brittany, France. A total of 80 hand-held, 15-cm-long box cores was taken at 20 stations and analyzed for visual oil content and sedimentary characteristics. Chemical samples also were taken and now are being analyzed. Preliminary investigation revealed a significant amount of oil incorporated into the bottom sediments within both areas, although the mechanisms of deposition probably were different. Generally higher oil concentrations were found in muddy sediments, sediments containing Lithothamnium, and in samples taken offshore of heavily oiled beaches. The depth of oil penetration was usually less than 7 cm (possibly related to the depth of biological reworking), except in the more porous Lithothamnium sediments, or in those areas close to heavily oiled beaches. Hand-held box coring techniques are more advantageous than other shipboard methods in that the problems associated with grab sampling are avoided, and complete control is maintained over the sample at all times. In addition, direct observations of bottom sediment variability and visible oil accumulation can be made. (Sinha-OEIS)  
W80-00153

#### ROLE OF DYNAMIC COASTAL PROCESSES IN THE IMPACT AND DISPERSAL OF THE AMOCO CADIZ OIL SPILL (MARCH 1978) BRITANNY, FRANCE

South Carolina Univ., Columbia. Dept. of Geology.

M. O. Hayes, E. R. Gundlach, and L. D'Ozouville.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979, p 193-198, 1979. 6 fig, 1 tab, 7 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

## Effects Of Pollution—Group 5C

**Descriptors:** \*Oil spills, Coasts, \*Geomorphology, Environmental effects, Sedimentation, Dispersion, Water pollution effects, \*Outer Continental Shelf, Amoco Cadiz Oil Spill, Brittany, Coastal processes, Vulnerability index.

Between 60,000 and 65,000 tons of the Amoco Cadiz oil came ashore along approximately 70 km of the shoreline of Brittany during the first few weeks of the spill. The details of oil erosion and burial were determined by resurveying 19 permanent beach profiles established during the first few days of the spill. These stations, plus an additional 147 beach observation stations, were revisited one month after the spill. Coastal processes and geomorphology played a major role in the dispersal and accumulation of the oil once it came onshore. For example, oil accumulated at the heads of crenulate bays and on tombolos (sand spits formed in the lee of offshore islands). Local sinks, such as scour pits around boulders, bar troughs (runnels), marsh pools, and joints and crevasses in rocks, tended to trap oil. Classification of the coastal environments of the Amoco Cadiz oil spill site, according to an oil spill vulnerability index (scale of 1-10 on basis of potential oil spill damage), revealed a good correlation with earlier findings at the Metula and Urquiola oil spill sites. These observations provide encouragement and incentive to continue to apply the vulnerability index to areas in the United States threatened by potential oil spills. (Sinha-OEIS) W80-00154

#### 10-YEAR OVERVIEW OF OIL SPILL CLEAN-UP AT SEA

International Tanker Owners Pollution Federation Ltd., London (England).  
I. C. White, J. A. Nichols, and M. J. Garnett.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 247-251, 1979. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil spills, \*Environmental effects, \*Water pollution effects, Coasts, Shores, Fisheries, Ecology, \*Outer Continental Shelf, Clean-up damages, Damage assessment.

The aim of this paper is to illustrate, by reference to experience gained from attendance on-site at major oil spills around the world, that the capability to combat oil on the high seas has improved little over the past ten years. Too often this failure has resulted in considerable areas of shoreline being severely oiled, damage being caused to areas of ecological, fishery, or amenity importance and has necessitated expensive clean-up measures being adopted that have on occasions been more damaging than the oil itself. The response options available for dealing with oil spills and their limitations are discussed and the importance of thorough and rapid evaluation to ensure that the response adopted is appropriate to the particular circumstances of the incident is emphasised. Also stressed is the necessity for good contingency planning, organisation and control. (Sinha-OEIS) W80-00155

#### IMPACT OF DISPERSANT USE DURING THE BRAZILIAN MARINA INCIDENT

Environmental Protection Agency, New York.  
R. T. Dewling, and C. C. Silva.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 269-276, 1979. 6 fig, 2 tab, 10 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil spills, \*Dispersion, \*Oil pollution, \*Water pollution effects, Environmental effects, Sediments, Detergents, Shores, Beaches, \*Outer Continental Shelf, Dispersant impact, Brazil, Brazilian Marina.

In January 1978, the tanker Brazilian Marina, while under way, struck rock in Sao Sebastiao Channel, Sao Paulo, Brazil, and spilled approximately 10,000 tons (3,000,000 gallons) of 31.4 API gravity Kuwait crude. Prevailing winds and cur-

rents carried the oil in a northeasterly direction, causing pollution of the coastal embayments and beach areas in the States of Sao Paulo and Rio de Janeiro. In an attempt to protect recreational and other public use areas, particularly the popular beaches of Ubatuba, undiluted dispersants were applied to remove oil accumulations from the shoreline. This response action while it cosmetically removed oil from the surface of the beaches, caused the oil to penetrate more deeply into the underlying sand, thus compounding the pollution and aesthetic problems attributable to the spill incident. Preliminary follow-up studies, conducted seven months after the incident, verified the persistence of the detergent-treated oil in the beach sand. (Sinha-OEIS) W80-00156

#### A CHEMICAL ASSESSMENT OF THE PRESENT LEVELS AND SOURCES OF HYDROCARBON POLLUTANTS IN THE GEORGES BANK REGION

Energy Resources Co., Inc., Cambridge, MA.  
For primary bibliographic entry see Field 5B.  
W80-00157

**COLD REGIONS SPILL RESPONSE**, Coast Guard, Washington, DC; and ARCTEC, Inc., Columbia, MD.  
G. D. Marsh, L. A. Schultz, and F. W. DeBord.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 355-358, 1979. 1 fig, 1 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil spills, \*Cold regions, \*Water pollution effects, Oil pollution, Ice cover, Lakes, Environmental effects, Great Lakes, Alaska, \*Outer Continental Shelf, Oil removal.

A cold regions oil pollution response system was defined through an engineering and cost effectiveness analysis of six oil spill scenarios, selected to encompass the broad range of oil spill and environmental conditions likely to be encountered offshore Alaska. Also identified were modifications to the system required to extend the response capability to the northern rivers, and the northern coastal regions. Three distinctly different types of spill response operations were identified: (1) for a thick, stable, level shorefast ice situation; (2) for a dynamic, hummocky, heavily concentrated broken ice situation; (3) for the case of light broken ice and open water. The presence of ice was found to aid response efforts in some cases and to hinder or preclude response efforts in others. This paper discusses the three types of spill response required for cold regions and reviews the six Alaskan and three lower 48 scenarios used to define the system requirements. (Sinha-OEIS) W80-00158

#### THE RESTORATION OF OILED SHORELINES BY THE PROPER USE OF CHEMICAL DISPERSANTS

Exxon Research and Engineering Co., Florham Park, NJ.  
G. P. Canevari.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 443-446, 1979. 4 fig, 2 tab, 10 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil spills, \*Water pollution effects, \*Shore protection, Environmental effects, Biodegradation, Weathering, Surfactants, Dispersion, \*Outer Continental Shelf, Oil removal, Dispersants.

The shortcomings of the expensive mechanical cleanup methods are reviewed and the overall mechanism and technique for restoration using chemical agents are presented. Although the use of chemicals in intertidal zones has not been well accepted by some environmental and regulatory groups, there is limited documentation that use of these agents results in less environmental damage and more rapid and economical shoreline restora-

tion than mechanical alternatives. In support of this argument, an actual instance wherein an extensive Tampa, Florida shoreline had been oiled by a spill from the S/S Delian Apollon and subsequently chemically restored, is described. Data from an oiled area, oiled and chemically cleaned area and a control (as is) area are supplied in the presentation. The implications and feasibility of simply allowing the oil to weather/biodegrade in areas where this would be permissible are discussed, as are the proper, as well as improper, applications of chemical agents for shoreline restoration. (Sinha-OEIS) W80-00159

#### BEHAVIOR AND EFFECTIVENESS OF DISPERSANTS AT SEA AND AT SHORELINES

Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.  
D. Mackay, A. Watson, C. Ng, and S. Nadeau.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 447-452, 1979. 4 fig, 1 tab, 10 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil pollution, \*Water pollution effects, \*Sediments, Shores, Beaches, Environmental effects, Wave action, Resources development, \*Outer Continental Shelf, Dispersants.

A laboratory experimental program was conducted in which the aims were to investigate quantitatively the factors which influence the effectiveness of chemical dispersants (1) when applied to oil under various open sea conditions, and (2) in modifying the behavior of oil advancing on a shoreline. Open sea conditions were simulated in a previously-devised dispersant effectiveness test apparatus. The effectiveness of a dispersant was shown to be profoundly influenced by turbulence level. An approach also was made to relating the turbulence level in the apparatus to natural environmental conditions. A simulated shoreline, impacted by waves from a wave generator, was used to examine the behavior of crude oil and No. 6 fuel oil on the shorelines with and without dispersant additions. Wave action caused sand beaches to 'filter' dispersed oil from the water column, resulting in enhanced, but possible reversible, oil penetration. Larger oil particles were observed to capture sand particles and sink. Implications of the results are that in many situations the use of dispersants on oil advancing on shores or even on the shoreline itself could prove advantageous. (Sinha-OEIS) W80-00160

#### DECISION CRITERIA FOR THE CHEMICAL DISPERSION OF OIL SPILLS

Woodward-Clyde Consultants, San Francisco, CA.  
R. W. Castle, and E. Schrier.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 459-463, 1979. 3 fig, 2 tab. American Petroleum Institute, Washington, D.C. Publication No. 4308.

**Descriptors:** \*Oil spills, \*Dispersion, \*Water pollution control, Environmental effects, Pollution abatement, \*Outer Continental Shelf, Dispersants, Decision analysis.

Chemical dispersion promises to play an increasing role in the control of oil spills in the United States. The question of when and how dispersants are best used to protect the environment is the subject of considerable controversy. This controversy is generated, on one hand, by insufficient understanding of real-world dispersant effectiveness and environmental implications, and on the other, by lack of guidelines by which all relevant factors can be considered together. With time, the first aspect will ultimately be resolved. This paper presents an approach to the second. While a certain degree of pre-planning and preliminary decision-making can be accomplished, ultimate decisions to conduct chemical dispersion should be made on a case-by-case basis. Criteria for determining the acceptability of chemically treating a specific incident include human risk, feasibility and adequacy of physical control and recovery, dispersibility of the oil,

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

logistic considerations, and whether dispersion will achieve a reduction in environmental impacts and interference with water usage. Assessed conservatively, these criteria should provide the basis for sound and acceptable decisionmaking. As knowledge in the use of dispersants improves, the validity of decisions using these criteria is expected to improve. (Sinha-OEIS)  
W80-00161

**APPLICATIONS OF ECOSYSTEM ANALYSIS TO OIL SPILL IMPACT,**  
British Petroleum Co. Ltd., London (England).  
E. B. Cowell, G. V. Cox, and G. M. Dunnet.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 517-519, 1979. 21 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Ecosystems, \*Environmental effects, Water pollution effects, Ecology, Biota, \*Outer Continental Shelf, Oil removal.

Ecologists need to be more involved in selection of oil spill clean-up devices, setting clean-up priorities, and evaluation of clean-up techniques. This paper outlines some basic ecological principles and stresses their proper application to minimize ecological damage and to properly evaluate that damage. (Sinha-OEIS)  
W80-00162

**ECOLOGICAL IMPACTS OF OIL SPILL CLEANUP: ARE THEY SIGNIFICANT,**  
Atlantic Richfield Co., Los Angeles, CA.  
J. L. Siva.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 521-524, 1979. 38 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Environmental effects, \*Water pollution effects, Ecology, Beaches, Oil pollution, \*Outer Continental Shelf, Oil removal.

Clear goals are needed in formulating and applying oil spill response plans whether at the level of the individual company, the oil cleanup cooperative, or the federal or state agency. There are two primary goals which have been considered, and problems arise from the fact that, in practice, these goals are not always compatible. The goals are: minimize the overall ecological impacts of the oil spill; and remove all visible spilled oil from the environment. This paper summarizes the findings of a task force of biologists organized by the Society of Petroleum Industry Biologists: reviews the ecological effects of various oil spill cleanup methods in several different habitat types; notes research needs; and recommends minimum-impact cleanup methods for specific environments. (Sinha-OEIS)  
W80-00163

**A PLAN FOR SCIENTIFIC RESPONSE TO AN OIL SPILL IN THE BEAUFORT SEA,**  
Fisheries and Marine Service, Winnipeg (Manitoba).  
D. G. Wright.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 525-532, 1979. 3 tab, 19 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Water pollution effects, \*Environmental effects, Pollution abatement, Planning, Future planning (Projected), \*Outer Continental Shelf, Beaufort Sea, Oil removal, Scientific Response Plan.

In anticipation that a major oil spill could occur in the Beaufort Sea, a Scientific Response Plan has been developed. The plan consists of 28 integrated scientific studies that would be conducted to assess the immediate impact of such a spill, to provide a base for the assessment of the long-term impact of the spill and to increase the knowledge (and hence

predictive capabilities) concerning the behaviour and fate of oil in Arctic marine environments. Memoranda of agreement to participate in the implementation of the plan have been signed by the participating agencies. Coordination of the Beaufort Sea Scientific Response Plan is the responsibility of Fisheries and Environment Canada, Fisheries and Marine Service. (Sinha-OEIS)  
W80-00164

**ARE PETROLEUM HYDROCARBONS AN IMPORTANT SOURCE OF MUTAGENS IN THE MARINE ENVIRONMENT,**  
Fisheries and Marine Service, St. John's (Newfoundland); and Memorial Univ. of Newfoundland, St. John's.

J. F. Payne, R. Maloney, and A. Rahimul.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 533-536, 1979. 5 tab, 35 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Environmental effects, Metabolism, Fish, Invertebrates, Enzymes, \*Outer Continental Shelf, \*Mutagens, Petroleum hydrocarbons, Polycyclic aromatic hydrocarbons.

It has now been established that the aromatic hydrocarbon hydroxylase enzyme system for activation of hydrocarbons to mutagens (and carcinogens) is present in all phyla of marine animals common to the coastal northwest Atlantic. Enzyme activity has been shown to increase in all fish species on exposure to petroleum but induction has never been observed in any invertebrate. Further studies have also been carried out on the relation between induction, hydrocarbon metabolism, and mutagen-carcinogen activation by fish liver enzymes. The Ames strains of bacteria sensitive to both frameshift and base pair substitutions have been used for mutagenesis testing. Of several different types (12) of crude and refined petroleum hydrocarbons assessed to date, only used engine oil has been observed to be mutagenic and this mutagenicity is increased in fish induced for AHH by petroleum. Evidence suggests that the mutagenic principal(s) in used engine oil is derived from gasoline combustion and thus only circumstantially related to petroleum pollution. The belief that oil-spill-derived hydrocarbons could be a primary source of mutagenic activity in the marine environment is argued. (Sinha-OEIS)  
W80-00165

**THE OCCURRENCE OF 'WHITE EYE SYNDROME' IN SHRIMP (PENAEUS AZTECUS),**  
Mississippi State Univ., Mississippi State.  
C. D. Minchew, L. R. Brown, and C. M. Ladner.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 537-539, 1979. 4 fig, 1 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Shrimp, \*Water pollution effects, Environmental effects, \*Outer Continental Shelf, Lesions, *Penaeus aztecus*, White eye syndrome.

Eye lesions observed in brown shrimp (*Penaeus aztecus*) which were chronically exposed to low levels of Empire Mix, Nigerian, and Saudi Arabian crude oils in 150 ft x 150 ft x 8 ft estuarine pond ecosystems are described. In live specimens, the lesions appeared as circular to slightly irregular white spots. In sectioned material, the lesions were characterized by the liquefactive necrosis of the crystalline cones, ommatidia, and all associated structures. Based on the appearance of these lesions in live specimens, this condition has been designated as the 'white eye syndrome.' (Sinha-OEIS)  
W80-00166

**RELATIONSHIP OF HYDROCARBON SOLUBILITY TO TOXICITY IN ALGAE AND CELLULAR MEMBRANE EFFECTS,**  
Toronto Univ. (Ontario).

T. C. Hutchinson, J. A. Hellebust, D. Mackay, D. Tam, and P. Kaus.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 541-547, 1979. 5 fig, 22 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Toxicity, \*Algae, \*Water pollution effects, Membranes, Aquatic life, Environmental effects, \*Outer Continental Shelf, Hydrocarbon solubility.

Toxicity has been determined in terms of the effects of hydrocarbons in solution on photosynthesis using <sup>14</sup>C-uptake as a measure. For each hydrocarbon, it was found that the molar concentration required to cause a 50% reduction in photosynthesis could be predicted from a knowledge of its solubility alone. A regression coefficient of 0.97 was obtained on a log plot. Chlorinated hydrocarbons behaved exactly as did other hydrocarbons. The effect of adding or subtracting methyl groups influenced toxicity through the effect on solubility. The linear toxicity/solubility response suggests a common mechanism of hydrocarbon action. Since hydrocarbons are lipophilic, it was hypothesized that the cellular membranes may be the site of cellular disruption. This has been tested by determining the amount of potassium and manganese leakage from algal cells, using neutron activation analysis, when exposed for a given time to equimolar concentrations of selected hydrocarbons. Loss of <sup>14</sup>C-labeled organic material has also been determined in previously tagged cells when exposed to these hydrocarbons. The predictions seem to be very strongly borne out. Implications for the prediction of effects of oil spills on a variety of aquatic organisms are present. The less soluble hydrocarbons are the most toxic on a per mole basis. Partition coefficients appear to provide a key to the common effects. (Sinha-OEIS)  
W80-00167

**SENSITIVITY OF 39 ALASKAN MARINE SPECIES TO COOK INLET CRUDE OIL AND NO. 2 FUEL OIL,**  
National Marine Fisheries Service, Auke Bay, AK.  
Northwest and Alaska Fisheries Center.  
S. D. Rice, A. Moles, T. L. Taylor, and J. F. Karinen.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 549-554, 1979. 1 fig, 3 tab, 11 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Aquatic life, \*Oil pollution, \*Water pollution effects, \*Environmental effects, Alaska, Fish, Invertebrates, Intertidal areas, Bioassay, \*Outer Continental Shelf, Crude oil, Fuel oil.

The sensitivities of 39 subarctic Alaskan species of marine fish and invertebrates to water-soluble fractions of Cook Inlet crude oil and No. 2 fuel oil were determined. This is the largest group of animals ever tested under similar test conditions with the same petroleum oils and analytical methods. Organisms bioassayed represent several habitats, six phyla, and 39 species including fish (9), arthropods (9), molluscs (13), echinoderms (4), annelids (2), and nemertean (2). Sensitivities were determined by 96-hour static bioassays. Sensitive pelagic animals are not necessarily more vulnerable to oil spills than tolerant intertidal forms—oil may damage intertidal environments more easily and adverse effects may persist longer than in damaged pelagic environments. (Sinha-OEIS)  
W80-00168

**THE RATES OF TRANSPORT AND FATES OF PETROLEUM HYDROCARBONS IN A CONTROLLED MARINE ECOSYSTEM, AND A NOTE ON ANALYTICAL VARIABILITY,**  
Rhode Island Univ., Kingston. Graduate School of Oceanography.  
J. N. Gearing, P. J. Gearing, T. Wade, and J. C. Quinn.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 555-564,

## Effects Of Pollution—Group 5C

1979, 8 fig, 3 tab, 20 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Ecosystems, \*Water pollution effects, Environmental effects, Evaporation, Biodegradation, Sediments, \*Outer Continental Shelf, Petroleum hydrocarbons, Transport mechanism, Analytical variability.

Four separate laboratories have cooperated in a study on the Marine Ecosystems Research Laboratory (MERL) tanks to which known amounts of water-accommodated No. 2 fuel oil have been added. A preliminary budget has been completed, indicating that the primary loss was to the atmosphere via evaporation. Biodegradation was important for some classes of hydrocarbons and increased with temperature and duration of oil exposure. Particulate material adsorbed hydrocarbons amounting to approximately 15% of the oil added to the tanks, and carried them to the sediment where 7-16% of the added oil was eventually found. The sedimentary hydrocarbons were depleted in low molecular weight aromatic compounds (up to three rings) relative to the original oil. An unexpected but valuable result of these studies has been a better understanding of the levels of variability to be expected when naturally inhomogeneous systems are studied by different methods in different laboratories. (Sinha-OEIS) W80-00169

**COMPARISON OF HYDROCARBONS IN BENTHIC FISH FROM COAL OIL POINT AND TANNER BANK, CALIFORNIA.**  
Scripps Institution of Oceanography, La Jolla, CA. Marine Biology Research Div.  
S. S. Rossi, G. W. Rommel, and A. A. Benson.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 573-577, 1979. 3 fig, 4 tab, 16 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Water pollution effects, Fish, Environmental effects, California, Benthos, \*Outer Continental Shelf, Hydrocarbons, Geographic variations, Sebastes sp, Citharichthys sp, Lysetta sp.

Hydrocarbons of rockfish (*Sebastes* sp.), sanddab (*Citharichthys* sp.), and sole (*Lysetta* sp.) were analyzed by high resolution glass-capillary gas chromatography; following saponification in methanolic-KOH, extraction by n-hexane, and separation via liquid chromatography. The fish contained a wide range of hydrocarbons. Some differences between species were noted: levels of biogenic constituents decreased in the order-sanddab to rockfish to slender sole. Fish collected during the summer exhibited hydrocarbon profiles similar to those taken during winter. Gravid females were characterized by somewhat higher levels of hydrocarbons. Subtle differences were observed between fish collected near Coal Oil Point, a region of intense natural petroleum influx, and Tanner Bank, an area some 140 km offshore. Animals from Tanner Bank contained lesser amounts of hydrocarbons with biogenic components often predominating over those of petroleum origin. These data, in combination with the absence of petrogenic characteristics among resolvable hydrocarbons, suggest that samples were contaminated by low levels of weathered petroleum. The most abundant hydrocarbon was squalene, which was present in every sample. The relevance of these findings to marine pollution monitoring strategies is briefly discussed. (Sinha-OEIS) W80-00170

**COMPARATIVE UPTAKE OF NAPHTHALENES FROM WATER AND OILED SEDIMENT BY BENTHIC AMPHIPODS.**  
Battelle Pacific Northwest Lab., Sequim, WA. Marine Research Lab.  
J. W. Anderson, S. L. Kiesser, and J. W. Blaylock.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 579-584, 1979. 2 fig, 5 tab, 22 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Environmental effects, \*Sediments, Metabolism, Amphipoda, \*Outer Continental Shelf, Hydrocarbons, Naphthalenes, Anonyx latidorsae.

The benthic amphipod, *Anonyx latidorsae*, was exposed to whole oil on sediments or water extracts of Prudhoe Bay crude oil under both static and flowing conditions. Time periods of exposure ranged from 4 to 27 days and, while a range of compounds was present, the only class measured in water, tissues, and sediments was naphthalenes. Compared to levels in the surrounding environment (sediment or water) tissue magnification was least during sediment exposures (2-4 times), greatest in a flowing exposure system (approx. 1000 times), and intermediate during static water exposure (10-15 times). During a constant exposure to 22 ppb total naphthalenes (0.506 ppm total hydrocarbons) the amphipods reached a threshold of accumulation after about seven days, and the majority of contamination was from alkylnaphthalenes. Sediment exposures demonstrated relatively low bioavailability of naphthalenes and the route of entry appeared to be via interstitial and water column contamination. It appears that release of naphthalenes from both oiled sediments and tissue is largely controlled by water solubilities of the components, but metabolic processes may supplement this activity. (Sinha-OEIS) W80-00171

**THE INTERACTIVE EFFECTS OF TEMPERATURE, SALINITY, AND SUBLETHAL EXPOSURE TO PHENANTHRENE, A PETROLEUM-DERIVED POLYCYCLIC AROMATIC HYDROCARBON (PAH), ON THE RESPIRATION RATE OF JUVENILE MUD CRABS, RHITHROPAEUS HARRISII.**  
Texas A and M Univ., College Station. Dept. of Biology.  
R. B. Laughlin, Jr., and J. M. Neff.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 585-590, 1979. 3 fig, 2 tab, 28 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Water pollution effects, \*Environmental effects, Temperature, Salinity, Crabs, Respiration, \*Outer Continental Shelf, Phenanthrene, Polycyclic aromatic hydrocarbons, Rhithropanopeus harrisi.

Laboratory-reared juvenile mud crabs, *Rhithropanopeus harrisi*, were acclimated to temperature-salinity combinations of 20, 25, or 30 degrees C and 5, 15, or 25 parts per thousand (o/oo) salinity. Subsequently, there were exposed for 10 days to phenanthrene. This gave a complete 3 x 3 x 4 factorial design of the factor combinations. On the tenth day of phenanthrene exposure the respiration rates of the crabs were determined both at steady state with the resting salinity, and immediately following a move from either 15 o/oo to 5 o/oo salinity (Hypocsmotic shock) or 15 o/oo to 25 o/oo salinity (Hyperosmotic shock). To a certain extent, all the factors tested affected the respiration rates. An increase in temperature usually caused an increase in the respiration rate, although this was small. The juvenile crabs were tolerant both to a wide range of acclimation salinities, and to osmotic shock under control conditions. However, phenanthrene-exposed animals showed marked changes in respiration compared to controls. In most cases, mean respiration rates of phenanthrene-exposed juveniles increase over control rates. However, the specific pattern was largely a function of all three variables tested. The percent body water of phenanthrene-exposed crabs tended to be higher than that of the controls. This may indicate that the phenanthrene-exposed animals had difficulty osmoregulating. The results of this study show that physical environmental factors such as temperature and salinity influence the nature and magnitude of the sublethal physiological response of an estuarine invertebrate to hydrocarbon pollution. (Sinha-OEIS) W80-00172

**DISTRIBUTION OF TAR AND RELATIONSHIP TO CHANGES IN INTERTIDAL ORGAN-**

**ISMS ON SANDY BEACHES IN SOUTHERN CALIFORNIA.**

University of Southern California, Los Angeles. Inst. for Marine and Coastal Studies.  
For primary bibliographic entry see Field 5B. W80-00173

**EFFECTS OF NO. 2 FUEL OIL ON CHEMICALLY-EVOKED FEEDING BEHAVIOR OF THE MUD SNAIL, ILYANASSA OBSOLETA.**  
Environmental Research Lab., Narragansett, RI. J. L. Hyland, and D. C. Miller.  
Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 603-607, 1979. 2 fig, 3 tab, 23 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Water pollution effects, Environmental effects, Animal behavior, Snails, Bioassay, \*Outer Continental Shelf, Feeding behavior, Fuel oil, Petroleum hydrocarbons, Ilyanassa obsoleta.

Chemically-mediated feeding responses of the mud snail, *Ilyanassa obsoleta*, were evaluated after exposure to various fractions and concentrations of No. 2 fuel oil in a continuous flow-through seawater system. This type of feeding response involves chemical perception of and movement toward a point source of food followed by feeding through an extended proboscis. To investigate the effects of oil on this behavior, two types of bioassays were employed. In the first, arousal was used as a criterion to document effects on initial perception of food (olfaction or distance chemoreception). This initial phase of the feeding response is particularly susceptible to disruption by oil, with significant inhibition occurring after 48 hours exposure to concentrations as low as 0.015 ppm of an oil-in-water dispersion (OWD) and 0.43 ppm of the water-accommodated fraction (WAF). In the second bioassay, extension of the proboscis was used as a criterion to document effects on subsequent tasting or contact chemoreception. This later phase of feeding is less sensitive to oil, with significant inhibition occurring only after one month exposure to 0.49 ppm WAF, or after 48 hours exposure to concentrations in excess of 1 ppm (1.45 ppm OWD and 5.97 ppm WAF). Other, more obvious effects, including mortality, were observed at these higher dose levels. This work illustrates the ability of extremely low levels of petroleum hydrocarbons to impair vital behavioral processes in marine organisms. (Sinha-OEIS) W80-00174

**HYDROCARBONS IN SEDIMENTS FROM THE EDGE OF THE BERMUDA PLATFORM.**  
Harvard Univ., Cambridge, MA. Div. of Applied Sciences; and Bermuda Biological Station, Ferry Reach.

T. D. Sleeter, J. N. Butler, and J. E. Barbash.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 615-620, 1979. 2 fig, 2 tab, 42 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Sediments, Water pollution effects, Environmental effects, \*Outer Continental Shelf, Bermuda, Hydrocarbons, Petroleum residues.

Surficial and subsurface (10-13 cm) sediment samples were taken at 7 stations (17 cores) on the northern margin of the Bermuda seamount, remote from ship traffic, beaches, and atmospheric fallout from aircraft. Their aliphatic (pentane-extractable) hydrocarbon content was found to be very low, comparable to samples from the North Atlantic abyssal plain, and two orders of magnitude lower than for typical coastal samples. About half of the aliphatic hydrocarbons are clearly biogenic, and the remainder are characteristic of petroleum residues. Petroleum hydrocarbon concentrations are lower in subsurface than surface samples, and are lower outside the reef than inside. These results are quantitatively consistent with a diffusion model. Extremely rapid bioturbation or totally quiescent deposition on a stable sedimentary facies can prob-

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

ably be eliminated as hypotheses for the deposition and transport mechanism within the sediment. Whether degradation is important cannot be answered without further studies. (Sinha-OEIS) W80-00175

#### MODELING THE ASSOCIATION OF PETROLEUM HYDROCARBONS AND SUB-ARCTIC SEDIMENTS

Alaska Univ., Fairbanks. Inst. of Marine Science. G. Malinky, and D. G. Shaw.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 621-623, 1979. 14 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Sediments, \*Water pollution effects, Path of pollutants, Model studies, Environmental effects, Alaska, \*Outer Continental Shelf, Petroleum hydrocarbons.

The extent of association between labeled hydrocarbons representing the major chemical classes of petroleum, and marine suspended sediments from south-central Alaska has been investigated in a series of laboratory experiments using hydrocarbon concentrations near or below saturated solution. For a saturated solution of either an aliphatic or aromatic hydrocarbon, the concentrations of hydrocarbon in parts per million (ppm) associated with sediment is roughly 30% of the original aqueous concentration in ppm. Extrapolation of these results to permitted discharge concentrations and dilution rates encountered in south-central Alaska indicates that concentrations of hydrocarbons sorbed to sediments are in the parts per trillion (ppt) to parts per billion (ppb) range. It appears that this process cannot be a major transport pathway for the disposal of oil under the conditions investigated. (Sinha-OEIS) W80-00176

#### C15+HYDROCARBONS IN THE SEDIMENTS OF THE NEW YORK BIGHT

National Marine Fisheries Service, Highlands, NJ. Sandy Hook Sport Fisheries Marine Lab. C. B. Koons, and J. P. Thomas.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 625-628, 1979. 2 fig, 1 tab, 21 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Sediments, \*Water pollution effects, Environmental effects, New York, \*Outer Continental Shelf, New York Bight, C15+hydrocarbons, Ocean dumping.

The purpose of this study was to document the distribution and abundance of C15+hydrocarbons in sediment samples taken from the Hudson River, the New York Harbor, and across the continental shelf to the continental rise. Collection of 35 of these samples took place in 1975-76 using a multiple corer, a bottom grab, or the submersible Alvin. Materials obtained from these areas were considered representative and included dredge spoils, sewage sludge, and sediment from both the Deepwater Dumpsite 106 on the continental rise and the comparatively cleaner sea floor of the continental shelf beyond the apex of the New York Bight. Total C15+hydrocarbons are most abundant (3000-6000 ppm) in areas highly impacted by man-harbor sediments and dredge spoil and sewage sludge disposal areas. Values from the continental shelf are lower (80 ppm) and values from the continental rise are the lowest (40 ppm). Gas chromatographic traces clearly distinguish the hydrocarbons in the dredge spoil and sewage sludge sediment samples from the hydrocarbons found in sediment samples relative free of sludge or spoil materials. (Sinha-OEIS) W80-00177

#### PETROLEUM HYDROCARBONS IN THE NORTH SEA

Institute of Marine Research, Bergen (Norway). O. Grahl-Nielsen, K. Westheim, and S. Wilhelmssen.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 629-632, 1979. 1 fig, 3 tab, 14 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Sampling, Water pollution, Environmental effects, Resources development, \*Outer Continental Shelf, North Sea, Petroleum hydrocarbons.

Since May 1976, a number of water samples have been collected from various areas in the North Sea. Most of the samples were taken at 1 m depth, but samples were also obtained from depths down to 100 m by the use of a specially-developed water sampler. The analysis was carried out by capillary gas chromatography with a mass spectrometer as detector. By selected ion monitoring, the petrogenic hydrocarbons naphthalene, phenanthrene, and dibenzothiophene as well as their alkyl derivatives were detected. The results show that the level of non-volatile petroleum hydrocarbons in the waters of the North Sea is very low indeed. A short residence time thus keeps the standing stock of petroleum hydrocarbons below the detection limit. (Sinha-OEIS) W80-00178

#### RESPONSE OF A SUBTIDAL SEDIMENT COMMUNITY TO LOW LEVELS OF OIL HYDROCARBONS IN A NORWEGIAN FJORD

Institute of Marine Research, Bergen (Norway); and Nordic Council for Marine Biology, Blomsterdalen (Norway).

T. Bakke, and T. M. Johnsen.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 633-639, 1979. 6 fig, 1 tab, 20 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Sediments, \*Benthos, On-site tests, Fjord, Nematodes, Environmental effects, Water pollution effects, \*Outer Continental Shelf, Norway.

During a nine-month field experiment, an artificial enclosed portion of the community on a subtidal sandy bottom was exposed to low levels of oil hydrocarbons for periods of two weeks at six week intervals. An adjacent portion of the community acted as a control. The oil input did not result in significant accumulation of aromatic hydrocarbons in the sediment, presumably due to biodegradation and loss to the enclosure walls. The fluctuation in numbers of sediment bacterial cells did not correlate with the oil stress. Generally, the sediment chlorophyll a content was significantly higher in the oiled sediment than in the control, which indicated decreased grazing by the sediment fauna and/or increased primary production under the oil stress. The nematode abundance decreased progressively in the oiled sediment compared to a seemingly steady state in the control, whereas the harpacticoid copepods showed no response to the oil stress. No significant short term fluctuations during the exposure periods were observed in any of the groups of organisms studied. The pollution level, although chemically significant, was not considered ecologically significant with respect to the benthos. (Sinha-OEIS) W80-00179

#### SELECTIVE OIL SPILL COMBAT PLANNING FOR OFFSHORE EXPLORATION AND PRODUCTION OPERATIONS IN THE NORTH SEA

Shell Internationale Petroleum Mij, The Hague (Netherlands).

J. P. Poley.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 641-647, 1979. 5 fig, 1 tab, 8 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Oil pollution, \*Water pollution effects, Resources development, Exploration, Environmental effects, Paths of pollutants, Planning, \*Outer Continental Shelf, North Sea, Production operations.

Experience shows that during emergencies (Ekofisk, Amoco Cadiz) considerable differences of opinion can arise concerning the best combat action to be taken, in spite of existing approved contingency plans. In this paper, a case is made for an improvement of the decision-making during emergencies through selective contingency planning for offshore operations. In such selective contingency planning, a spill from a specific (potential) source and its impact on a stretch of coastline are being interconnected and analysed. This will involve consideration of source-specific data (such as location, oil-composition, flow-rates, and temperatures), together with such items as estimates of the fate and movement of that oil across the intermediate stretch of sea, seasonal conditions, pollution risks in terms of oil arrival times and amounts, and coastal vulnerability. In consultation between government and industry, a scenario for action tailored to that situation then can be decided in advance, both for combat at the spill location and for coastal protection. The paper is illustrated with evidence from the Ekofisk blow-out case, and with the estimated pollution hazard for the Dutch Waddenzee from an oil blow-out in the central North Sea area. (Sinha-OEIS) W80-00180

#### OIL SPILL FORECASTING—WHERE IS IT GOING

Coast Guard Research and Development Center, Groton, CT.

I. M. Lissauer, and D. L. Murphy.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 649-652, 1 fig, 17 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Forecasting, \*Model studies, \*Path of pollutants, Resources development, Environmental effects, Water pollution effects, Movement, Evaporation, Dispersion, \*Outer Continental Shelf, Transport models.

The methods used to forecast the movement of spilled oil have not changed significantly since the Argo Merchant spill. Little has been done to improve the deficiencies brought to light during this incident. Some of the deficiencies in the state-of-the-art are examined here, particularly those related to our incomplete knowledge of the physical mechanisms involved in oil spill movement. A basic framework for the development of an improved forecasting system is presented. It is based on the integration of a horizontal transport model, an evaporation model, and a vertical dispersion model. (Sinha-OEIS) W80-00181

#### A MODEL TO FORECAST THE MOTION OF OIL ON THE SEA

National Weather Service, Silver Spring, MD. Techniques Development Lab.; and Princeton Univ., NJ. Dept. of Civil Engineering.

K. W. Hess, and C. L. Kerr.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 653-663, 1979. 8 fig, 2 tab, 18 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Forecasting, \*Model studies, \*Path of pollutants, Movement, Water pollution effects, Environmental effects, Oil-water interfaces, \*Outer Continental shelf.

A model to forecast the motion of oil spilled on the surface of water was established by combining separate models for the motion of oil, the motion of water, and the motion of air. The model for the motion of oil is based upon the hydrodynamic equations as they apply to oil on water. This model requires information at both the lower and upper boundaries of oil. At the oil lower boundary, the information is obtained from a model for the motion of water. This model is formulated by combining Ekman dynamics and continuity for the upper mixed layer of the sea. At the oil upper boundary, a model for the motion of air provides the required information. This model is based upon

## Effects Of Pollution—Group 5C

an analysis of output obtained from one of the National Weather Service's multi-level atmospheric models. A number of case studies demonstrate the features of the separate models and the composite oil spill model. (Sinha-OEIS)  
W80-00182

## EFFECTS OF AN OIL SLICK ON WIND WAVES,

Flow Research Co., Kent, WA.

H-T. Liu, and J-T. Lin.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 665-674, 1979. 15 fig, 4 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Oil spills, \*Waves(Water), Laboratory tests, Water pollution effects, Environmental effects, \*Outer Continental Shelf, Wind waves.

Laboratory experiments were performed to investigate the effects of an oil slick on ocean waves. This is part of an integrated program aimed at understanding the vertical dispersion of oil in the upper ocean. The experiments were conducted in a wind-wave tank which measured 9.1 m long, 1.2 m wide, and 1.8 m deep. Both wind waves and mechanically-generated waves with wind were considered. No. 2 Diesel oil was fed at a rate of 0.35 liters/sec onto the water surface from the upstream end of the wave tank. To measure the wave profiles, an optical sensor-photodiode wave gauge was developed and is described herein. The effects of an oil slick on wind waves were examined in terms of wave profiles and rms wave amplitudes. For wind waves, the presence of the oil slick damps the waves significantly. The amount of damping increases with the wind speed. The rms amplitudes of the wind-generated waves increase with the fetch without the oil slick, but they do not change appreciably in the presence of the oil slick. For mechanically-generated waves with wind, wave damping by the oil slick becomes insignificant when the waves are sufficiently steep and wave breaking occurs. Prior to wave breaking, however, steepening of the wave crests due to the presence of the oil slick has been observed occasionally as a result of the reduction in the surface tension by the oil film. (Sinha-OEIS)  
W80-00183

## PREDICTION OF THE MOTION OF OIL SPILLS IN CANADIAN ARCTIC WATERS,

Atmospheric Environment Service, Downsview (Ontario); and Atmospheric Dynamics Corporation, Elmira, Ontario.

S. Venkatesh, H. S. Sahota, and A. S. Rizkalla.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-23, 1979. p 677-683, 1979. 8 fig, 1 tab, 10 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Forecasting, \*Model studies, \*Movement, Environmental effects, Water pollution effects, On-site testing, Arctic, Cold regions, \*Outer Continental Shelf, Prediction, Wind driven currents, Beaufort Sea, Bay of Fundy.

An oil spill movement prediction model operating as part of a real-time Environmental Prediction Support System for the Canadian Beaufort Sea has been developed. The present version of the model considers spills only in open waters, that is, the sea surface is considered to be ice free. The model has been partially verified with data obtained from oil simulation experiments conducted in the Bay of Fundy, off the east coast of Canada during the months of August and September, 1978. With the use of observed winds, the model-predicted locations of 'Orion' buoys used to simulate the motion of oil on water, agreed fairly well with their observed locations. These verification tests also pointed out the need for high resolution surface wind forecasts—essential data for computing wind-driven water currents which move the oil. (Sinha-OEIS)  
W80-00184

## OIL SPILL TREATMENT STRATEGY MODELING FOR GEORGES BANK,

Rhode Island Univ., Kingston. Dept. of Ocean Engineering.

P. C. Cornillon, M. L. Spaulding, and K. Hansen.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 685-692, 1979. 15 fig, 3 tab, 15 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Model studies, \*Fisheries, Environmental effects, Water pollution effects, Paths of pollutants, \*Outer Continental Shelf, Georges Bank, Oil removal, Prediction.

As part of a larger project assessing the environmental impact of treated versus untreated oil spills, a fates model has been developed which tracks both the surface and subsurface oil. The approach used to spread, drift, and evaporate the surface slick is similar to that in most other oil spill models. The subsurface technique, however, makes use of a modified particle-in-cell method which diffuses and advects individual oil/dispersant droplets representative of a large number of similar droplets. This scheme predicts the time-dependent oil concentration distribution in the water column, which can then be employed as input to a fisheries population model. In addition to determining the fate of the untreated spill, the model also allows for chemical treatment and/or mechanical cleanup of the spilled oil. With this capability, the effectiveness of different oil spill control and removal strategies can be quantified. The model has been applied to simulate a 34,840 metric ton spill of a No. 2-type oil on Georges Bank. The concentration of oil in the water column and the surface slick trajectory are predicted as a function of time for chemically treated and untreated spills occurring in April and December. In each case, the impact on the cod fishery was determined and is described in detail in a paper by Reed and Spaulding presented at this conference. (Sinha-OEIS)  
W80-00185

## CHEMICAL INVESTIGATIONS OF TWO EXPERIMENTAL OIL SPILLS IN AN ESTUARINE ECOSYSTEM, PART II,

Virginia Inst. of Marine Science, Gloucester Point; and College of William and Mary, Williamsburg, VA.

R. H. Bieri, V. C. Stamoudis, and M. K. Cueman.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 693-697, 1979. 1 fig, 4 tab, 6 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Oil pollution, \*Ecosystems, \*Sediments, Testing, Environmental effects, Water pollution effects, Oysters, Marshes, Estuaries, Intertidal areas, \*Outer Continental Shelf, Hydrocarbons, Chlorinated hydrocarbons, Aromatic hydrocarbons, Crassostrea virginica.

Hydrocarbons in unconsolidated sediment and oysters, *Crassostrea virginica*, exposed to experimental oil spills are discussed. Quantitative data are based on high resolution, wall coated glass capillaries, and compound identification on mass spectrometry and retention. Unconsolidated sediment extracts were found to contain chlorinated hydrocarbons in concentrations of the same order of magnitude as those of aromatic hydrocarbons. While a few chlorinated hydrocarbons were also detected in oysters, their concentrations relative to aromatic hydrocarbons was low and their structure in general different from those in unconsolidated sediments. Contrary to expectations, there is no obvious correlation between unconsolidated sediment and oysters. (Sinha-OEIS)  
W80-00186

## SURVEY OF THE EFFECTS OF THE SETO INLAND SEA OIL SPILL IN 1974,

Tokyo Univ. (Japan). Museum.

Y. Hiyama.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 699-707,

1979. 7 fig, 7 tab, 3 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Water pollution effects, \*Environmental effects, Biodegradation, Weathering, Fisheries, Sediments, \*Outer Continental Shelf, Oil removal, Seto Inland Sea(Japan), Seaweeds.

On December 18, 1974, a fuel oil tank in Mizushima Refinery of Mitsubishi Oil Co. ruptured. About 50,000 barrels of fuel oil spilled and spread in the Seto Inland Sea, where there were intensive fisheries and heavy marine traffic among various industrial settlements. Coastal fisheries and fish culture fell into confusion, but, according to this survey, marine life quickly recovered by the summer of 1975 and the effect of the oil on the natural environment was not so large as suspected, the reason being mainly the quick and energetic work to recover the spilled oil. This paper is a report of the outline of the accident and a survey of its influence on the marine environment. (Sinha-OEIS)  
W80-00187

## HYDROCARBON DISTRIBUTION AND WEATHERING CHARACTERISTICS AT A TROPICAL OIL SPILL SITE,

Bowdoin Coll., Brunswick, ME. Marine Research Lab.

D. S. Page, D. W. Mayo, J. F. Cooley, and E. Sorenson.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 709-712, 1979. 4 fig, 2 tab, 6 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Oil pollution, \*Weathering, \*Tropical regions, Water pollution effects, Environmental effects, Puerto Rico, \*Outer Continental Shelf, \*Biogenic hydrocarbons, Caribbean, Zoe Colocotroni spill.

A study was performed on the state of an oil spill site on the southwest coast of Puerto Rico. The location of the study was Bahia Sucia, the site of the Zoe Colocotroni spill of 17 March, 1973. Particular attention was given to the weathering characteristics of the stranded oil remaining at the sites and to the presence of biogenic hydrocarbons in the sediments. It was observed that oil weathers much more rapidly in a tropical environment as compared with spills in temperate areas. Even in the most heavily impacted areas, the Zoe Colocotroni oil had weathered practically to the point of being tar. It was also observed that a tropical site has a significant chronic input of hydrocarbons from both natural and anthropogenic sources. The conclusion is that a tropical area has the potential for making a much more rapid recovery from an oil spill than a temperate one. Moreover, in assessing the effects of a tropical oil spill, care must be taken to distinguish the relative contribution to the total hydrocarbon burden in a spill area by oil, pelagic tar, and biogenic sources. (Sinha-OEIS)  
W80-00188

## PROBLEMS IN ECOLOGICAL MONITORING IN PORT VALDEZ, ALASKA,

British Petroleum Trading Ltd., London (England); and British Petroleum Co. Ltd., Sunbury-on-Thames (England). Research Centre.

E. B. Cowell, and D. C. Monk.

In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 713-717, 1979. 5 fig, 23 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil pollution, \*Monitoring, \*Ecology, Water pollution effects, Baseline studies, Resources development, Environmental effects, Alaska, \*Outer Continental Shelf, Port Valdez(AK), Collisella pelta.

The technical and scientific problems of ecological monitoring at Port Valdez, Alaska are discussed. Particular attention is given to the lack of understanding of the processes of the Alaskan Rocky

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Shore ecosystem and the paucity of data on the natural stresses controlling temporal and spatial variation in populations. In addition, taxonomic difficulties, particularly in the littoral macro-algae, further compound survey problems. The paper suggests some possible approaches that could be applied and is illustrated by data taken on baseline surveys made in 1977. Particular attention is given to unexpected age size distribution in the limpet *Collisella pelta*. (Sinha-OEIS)  
W80-00189

**THE SURVIVAL OF OIL SLICKS ON THE OCEAN AS A FUNCTION OF SEA STATE LIMIT.**  
Little (Arthur D.), Inc., Cambridge, MA; and Coast Guard, Washington, DC.  
P. P. K. Raj, and R. A. Griffiths.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 719-724, 1979. 4 fig. 10 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Oil pollution, \*Dispersion, \*Path of pollutants, Water pollution effects, Environmental effects, Turbulence, Waves (Water), \*Outer Continental Shelf, Sea state, Breaking waves.

A research program is underway to obtain a better understanding of the interaction between spilled oil and sea state in order to predict the dispersion and ultimate physical fate of oil spilled in rough water. In pursuit of this goal, a theoretical study and two laboratory experimental studies are now complete. As a consequence, the lower limit of sea state at which globular dispersion of oil can be effected by ocean turbulence is calculable. The formation of oil globules by breaking waves, the penetration of globules into the water column, and the distribution of oil under breaking wave generated turbulence can also be modeled. A possible mechanism by which a coherent oil slick breaks up into small patches of oil ('slicklets'), caused by breaking waves, is described, and a simplified one-dimensional model of this effect is proposed. Results indicate that a 3 meter (significant wave height) sea will tend to initiate globular vertical dispersion of oil, although this process would take place over only about 13% of the oil slick's area. To effect a horizontal surface dispersion, breaking waves with a very long crest length are necessary, a type not ordinarily found in deep water. (Sinha-OEIS)  
W80-00190

**A TIDAL SIMULATION SYSTEM FOR ESTUARINE ECOSYSTEM RESEARCH.**  
Mississippi State Univ., Mississippi State.  
R. A. Johnson, L. R. Brown, and W. G. Wells.  
In: Proceedings 1979 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), held in Los Angeles, California, March 19-22, 1979. p 725-728, 1979. 5 fig. 3 ref. American Petroleum Institute, Washington, D.C. Publication No. 4308.

Descriptors: \*Oil spills, \*Estuaries, \*Ecosystems, \*Tidal effects, \*Testing, Water pollution effects, Environmental effects, Simulation analysis, Gulf of Mexico, \*Outer Continental Shelf, US Gulf coast, Tidal Simulation System (TSS).

A system is described for simulating tidal movements in an enclosed salt-water (estuarine) environment. This Tidal Simulation System (TSS) can be programmed to deliver various tide levels on variable cycles, and can record system performance analog data output on strip charts. Employing a variable-speed centrifugal pump, a system of pneumatic valves actuated by a central timing device, a pressurization subsystem, and a special piping manifold, the system controls flow through a branched array of submerged outlet pipes which prevent disruption of surface water and oil films, and prevent disturbance of bottom sediments. The system has undergone extensive operation tests in the Ecosystem Research Laboratory of the Mississippi State University Research Center, situated at the NASA National Space Technology Laboratory (NSTL) at Bay St. Louis, Mississippi, and has been used to simulate tides in two pairs of ponds

which were employed on an Environmental Protection Agency contract to study the fate and effect of oil in the aquatic environment of the Gulf Coast Region. The salinity of the ponds ranged from 6 to 12 parts per thousand (o/oo), and the composition of the plankton population changed with salinity and paralleled changes observed in the estuarine area of the south-central Gulf area. Several effects of low level oil pollution, not found in laboratory studies, were observed during the course of an eleven-month study. (Sinha-OEIS)  
W80-00191

**GUIDELINES FOR SURFACE WATER QUALITY, VOL. 1 INORGANIC CHEMICAL SUBSTANCES ARSENIC.**  
Department of the Environment, Ottawa (Ontario). Water Quality Branch.  
A. Demayo, M. C. Taylor, and S. W. Reeder.  
1979. 13 p, 1 fig, 97 ref, 1 append.

Descriptors: \*Surface waters, \*Water quality, \*Inorganic compounds, \*Toxicity, Vegetation, Public health, Aquatic life, Wildlife, Livestock, Irrigation water, Water utilization, Recreation.

A literature survey was carried out on the toxic effects of arsenic and arsenic compounds on human health, aquatic life, plants and livestock. The information is summarized in this publication. From it, maximum arsenic concentrations in water at which toxic effects will not appear are recommended. (WATDOC)  
W80-00194

**PESTICIDES MONITORING IN THE PRAIRIES OF WESTERN CANADA.**  
Saskatchewan Dept. of the Environment, Regina. Inland Waters Directorate.  
W. D. Gummer.  
Paper presented at the International Symposium on the Analysis of Hydrocarbons and Halogenated Hydrocarbons, Burlington, Ontario, May 1978, Water Quality Interpretive Report No. 4, 1979, 14 p, 4 fig, 8 tab, 35 ref.

Descriptors: \*Pesticides, \*Monitoring, \*Surface waters, \*Water quality, Aquatic habitats, Environmental effects, \*Prairie, \*Western Canada, Isomerization.

Pesticide monitoring programs conducted by the Water Quality Branch of the Department of the Environment during the period 1971 to 1977 revealed a widespread distribution of 2,4-D; 2,4,5-T; gamma-BHC (lindane); and alpha-BHC as well as a more limited distribution of 2,4-DP (dichloroprop); aldrin; and beta-Endosulfan in surface waters of western Canada. Atmospheric transportation and deposition are the mechanisms believed responsible for the wide distribution of lindane and alpha-BHC in western Canada. It is speculated that isomerization of lindane to the alpha-BHC isomer accounts for the abundance of alpha-BHC. Concentrations of both lindane and alpha-BHC at times exceeded 0.01 micro g per L. The herbicide, 2,4-D was prevalent in the agricultural areas at concentrations above 0.01 micro g per L and as high as 4.33 micro g per L. In addition to agriculture, industries and municipalities were found to contribute pesticides to the aquatic environment. (WATDOC)  
W80-00198

**BIOACCUMULATION AND TOXICITY OF HEAVY METALS AND RELATED TRACE ELEMENTS.**  
Geological Survey, Menlo Park, CA. Water Resources Div. and Oak Ridge National Lab., TN.  
H. V. Leland, S. N. Luoma, and J. M. Fielden.  
Journal of the Water Pollution Control Federation, Vol. 51, No. 6, p 1592-1616, June 1979. 3 tab, 199 ref.

Descriptors: \*Reviews, \*Toxicity, \*Heavy metals, \*Trace elements, \*Aquatic life, Ecosystems, Water pollution effects, Aquatic environment, Benthic fauna, Freshwater fish, Marine fish, Estuarine fisheries, Aquatic animals, Water birds, \*Literature review.

In contrast to those of the past several years, this review is confined to a discussion of bioaccumulation and toxicity of heavy metals and related trace elements. The decision to narrow the scope of the review reflects a large body of literature now available on trace element distributions and their environmental effects. Included in this review are reports dealing directly with concentrations or activities of trace elements in aquatic ecosystems and the impact of these trace constituents on aquatic life. Included is a bibliography containing 199 literature references. (Woodard-USGS)  
W80-00237

**REGIONAL ANALYSIS OF ECONOMIC ACTIVITY, RESOURCE MANAGEMENT AND LAKE EUTROPHICATION: A CASE STUDY OF ITASCA COUNTY, MINNESOTA.**  
Minnesota Univ., St. Paul. Coll. of Forestry.  
A. P. O'Hare, and A. C. Mace.  
In: Watershed Management. Proceedings of a Symposium conducted by the Irrigation and Drainage Division of the American Society of Civil Engineers, Logan, Utah, August 1975. p 397-614, 1975. 4 fig, 1 tab, 17 ref. ASCE, New York, N.Y.

Descriptors: \*Regional analysis, \*Economic impact, \*Environmental effects, \*Lakes, \*Eutrophication, Itasca County (MN), \*Monte Carlo method, \*Input-output analysis, \*Watersheds (Basins), \*Methodology, Simulation analysis, Urban runoff, Planning, Decision making, Water quality, Mathematical models, Systems analysis, Agricultural land, Forest land, Nutrient losses, Resource management.

To establish the link between residuals discharge and water quality criteria on a regional basis, it is necessary to consider the distribution of residuals discharge over the region and the resulting distribution in water quality. Developed is a conceptual and quantitative framework for predicting the economic and water quality effects of alternative decisions in a natural resource-based economy. The study region is Itasca County, a scenic area in north central Minnesota with a strong minerals, recreation and forest resource base. Considered is the quality of the large number of lakes in the county, including nonpoint as well as point sources of residuals. Input-output analysis is used; the approach is a simulation model for estimating direct plus indirect economic and pollution effects resulting from changes in technology or in final demand in various sectors of the economy. Essential model elements are: (1) the Leontief inverse of an input-output matrix of the economy and (2) an environmental linkages matrix showing the residuals outflow to the environment associated with one dollar of gross output of each economic sector. Monte Carlo simulation is used to derive the distribution of trophic state index and of nutrient loadings from watersheds and to describe regional lake water quality for proposed timber harvest alternatives. (Bell-Graf-Cornell)  
W80-00254

**THE EFFECTS ON WATER QUALITY BY MINING ACTIVITY IN THE MIAMI, ARIZONA REGION.**  
Arizona State Land Dept., Phoenix.  
D. W. Young, and R. B. Clark.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-American Association of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 137-145, 4 fig, 2 tab, 18 ref.

Descriptors: \*Water quality, \*Water pollution sources, \*Mine wastes, \*Potable water, \*Water allocation, Acid mine water, Water quality standards, Domestic water, Industrial water, Aquifer characteristics, Leachate, Social function, Economic effects, Arizona.

The town of Miami, Arizona in the southern portion of Gila County, Arizona, has been faced with ever-decreasing potable water supply problems due to the quality degradation brought about by copper mining since the late 1800s. Water quality

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

in this region, which is underlain by two aquifers which historically and at present serve as the principal industrial and private domestic water supply, is analyzed with the following conclusions: (1) the historic surface and underground mining activity within the region has contributed, and in all probability will continue to contribute to water quality degradation in both the flood plain and Gila Conglomerate aquifers, (2) the waters of the shallow floodplain aquifer are chronically chemically polluted and exceed USPH drinking water standards, (3) the Gila conglomerate and Pinal Schist are highly faulted throughout the region causing potential problems of acid leachate escaping, and (4) small mining communities such as the town of Miami typically have an interwoven socio-economic interdependence with large corporation mining activity. (Tickes-Arizona) W80-00287

**WATER QUALITY PROBLEMS OF THE URBAN AREA IN AN ARID ENVIRONMENT. TUCSON, ARIZONA.**  
Pima Association of Governments, Tucson, AZ. G. Hansen.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 185-193, 1 tab, 1 fig.

Descriptors: \*Urban hydrology, \*Water quality, \*Water pollution effects, \*Water quality control, \*Planning, \*Pima County, Arizona, Surface runoff, Urban sociology, Regional analysis, Municipal wastes, Industrial wastes, Septic tanks, Groundwater availability, Hydrologic systems, Hydrologic cycle, Landfills, Leachate, Groundwater recharge, Aquifer systems, Water supply, Water reuse, Water harvesting, Storm runoff, Sewage effluents.

The U.S. Environmental Protection Agency's two-year 208 area-wide Water Quality Management Study for Pima County, Arizona, is discussed in terms of the specific problems of municipal wastewater effluent, industrial wastewater, urban stormwater runoff, land disposal of residual wastes, septic systems, and construction activities related to the City of Tucson urban area. The primary groundwater and the slow cycling of the hydrologic system in this arid urban environment reduce many water pollution problems to insignificant levels in the short term, (2) there does exist significant long-term pollution problems in the area. These problems include urban stormwater runoff and landfill leachate, and are related to the pollution of groundwater recharge and aquifer water supplies, and (3) there is a strong need for total water resource planning in arid urban areas which includes planning for wastewater reuse, water harvesting, and proper management of groundwater recharge systems. (Tickes-Arizona) W80-00294

**FISHERY SURVEY OF CEDAR LAKES AND THE BRAZOS AND SAN BERNARD RIVER ESTUARIES.**  
Texas Parks and Wildlife Dept., Austin.  
For primary bibliographic entry see Field 2H. W80-00305

**VIRUS CONSIDERATION IN LAND DISPOSAL OF SEWAGE EFFLUENTS AND SLUDGE.**  
Epidemiology Research Center, Tampa, FL. Dept. of Health and Rehabilitative Services.  
For primary bibliographic entry see Field 5A. W80-00306

**UTILIZATION OF OXYGEN MODELS IN ENVIRONMENTAL IMPACT ANALYSIS.**  
McMaster Univ., Hamilton (Ontario).  
W. J. Snodgrass, and M. F. Holloran.  
In: Water Pollution Research in Canada 1977. Proc. of Twelfth Canadian Symp. on Water Poll. Research, Univ. Toronto, Feb. 1977, and Eastern Div. Symp., Concordia Univ., Montreal, Dec. 1976, p 135-156. 7 fig, 2 tab, 14 ref.

Descriptors: \*Reservoirs, \*Oxygen, \*Environmental effects, \*Mathematical models, Simulation analysis, Aquatic environment, Measurement, Temperature, Management, Water quality, Projects, Dissolved oxygen, Sensitivity analysis, Sediments, Decision making, Prediction, Operating policy, Constraints, Fontana Reservoir (North Carolina).

A vertical one-dimensional temperature-oxygen model for reservoirs is used to estimate zones of stress on the aquatic environment of a series of reservoirs in Nova Scotia. Application to cold climates has necessitated a few novel developments for the temperature model. The oxygen model whose sinks are water column decay and sediment oxygen demand (DOS) is calibrated using under ice measurements of oxygen stocks and laboratory and in situ measurements of a zero-order kinetic model for sediment oxygen demand. These extensive studies are complementary and indicate a winter SOD of 0.1 gm O<sub>2</sub>/m<sup>2</sup>/day and a higher summer value. High epilimnetic temperatures coupled with the predicted anoxic zones in lower waters cause a major stress upon fisheries potential. This model provides a tool for determining the effects of different reservoir management strategies upon water quality and for selecting among these strategies. (Bell-Graf-Cornell) W80-00312

**EFFECTS OF ACIDIC PRECIPITATION ON PRECAMBRIAN FRESHWATERS IN SOUTHERN ONTARIO.**  
Ontario Ministry of the Environment, Rexdale. Limnology and Toxicity Section.  
For primary bibliographic entry see Field 5A. W80-00344

**TOXICITY OF 4-CHLORO-O-CRESOL TO FISH. LIGHT MICROSCOPY AND CHEMICAL ANALYSIS OF THE TISSUE.**  
Jyväskylä Univ. (Finland). Dept. of Chemistry.  
For primary bibliographic entry see Field 5A. W80-00391

**PESTICIDE INDUCED HAEMATOLOGICAL ALTERATIONS IN A FRESH WATER FISH SACCOBRANCHUS FOSSILIS.**  
D.A.V. Coll., Muzaffarnagar (India). Dept. of Zoology.  
S. R. Verma, S. K. Bansal, A. K. Gupta, and R. C. Dalia.  
Bulletin of Environmental Contamination and Toxicology, Vol. 22, p 467-474, 1979. 2 tab, 24 ref.

Descriptors: \*Pesticide toxicity, \*Fish physiology, Teleosts, Chlorinated hydrocarbon pesticides, Animal metabolism, Biochemistry, Chemical analysis, Protein, Calcium, Magnesium, Sodium, Iron, Chlorides, \*Chlordane, \*Tissue analysis, \*Hematology.

The effect of chlordane on hematological parameters in the freshwater teleost, *Saccolabrus fossilis*, was investigated. Fish were exposed to 0.12 mg/L chlordane for 60 days. Blood samples were taken at 15 day intervals. Several factors like haemoglobin percentage, RBC, WBC, and hematocrit value (PCV) were found increased while erythrocyte sedimentation rate (ESR) and clotting time were found decreased. It was also observed that out of the 12 blood constituents analysed, glucose, lactate, non-protein nitrogen, sodium, potassium, calcium, magnesium, iron and chloride increased while other two i.e. proteins and cholesterol decreased after exposure to pesticide. (Deal-EIS) W80-00392

**TISSUE ENZYME ACTIVITIES FOLLOWING EXPOSURE TO DIETARY MIREX IN THE CHANNEL CATFISH, ICTALURUS PUNCTATUS.**  
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.  
For primary bibliographic entry see Field 5A. W80-00395

**EFFECT OF DISTILLERY WASTE ON SOME FRESHWATER TELEOSTS-BIOCHEMICAL STUDIES.**  
D. A. V. Coll., Muzaffarnagar (India). Dept. of Zoology.  
For primary bibliographic entry see Field 5B. W80-00396

**ACCUMULATION OF CADMIUM BY DUNALIELLA TERTIOLECTA BUTCHER.**  
Queen Mary Coll., London (England). Dept. of Zoology and Comparative Physiology.  
For primary bibliographic entry see Field 5A. W80-00398

### 5D. Waste Treatment Processes

**PROCESS FOR TREATMENT OF SEWAGE IN A GRAVITY SEWER.**  
K. C. Smith.  
U.S. Patent No. 4,148,726, 4 p, 1 fig, 12 ref; Official Gazette of the United States Patent Office, Vol. 981, No. 2, p 603, April 10, 1979.

Descriptors: \*Patents, \*Waste water treatment, \*Sewage treatment, Water pollution treatment, Oxygenation, Odor, Sewers, Oxygen, Hydrogen sulfide, Equipment.

Pure oxygen or a gas containing more oxygen than air is injected under pressure into sewage held in or flowing through a sewer. This injection can be used to prevent the concentration of dissolved oxygen in the sewer falling to a level at which there occurs bacterial reduction to hydrogen sulfide of sulfate present in the sewage. The injection can also be used to oxidize to sulfur any sulfide dissolved in the sewage. The pure oxygen or the gas containing more oxygen than air may be injected into sewage flowing through a sewage pipe forming part of a gravity sewer, into a pump used to transfer the sewage through the sewer, or into a part of the sewer where sewage is collected before being transferred through the sewer. (Sinha-OEIS) W80-00008

**A COST-EFFECTIVE SWIRL COMBINED SEWER OVERFLOW REGULATOR/SOLIDS-SEPARATOR.**  
Municipal Environmental Research Lab., Cincinnati, OH.  
For primary bibliographic entry see Field 4A. W80-00057

**2ND USA/USSR SYMPOSIUM ON PHYSICAL/CHEMICAL TREATMENT FROM MUNICIPAL AND INDUSTRIAL SOURCES, HELD AT THE TAFT CENTER, CINCINNATI, OHIO, NOVEMBER 12-14, 1975.**  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-266 702. Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency, Washington, DC. 1975. 177 p.

Descriptors: \*Chemical reactions, \*Treatment, \*Physicochemical properties, \*Chemical industry, Oil industry, Municipal wastes, Sewage treatment, Sludge treatment, Waste water treatment, Tertiary treatment, Industrial wastes.

The application of physical-chemical treatment of wastes from municipal and industrial sources was discussed at the second cooperative symposium attended by delegations from the U.S. and the USSR. A total of 18 papers were included in the proceedings. Research and development, applications, economics, full-scale data and other aspects of physical-chemical treatment of municipal and industrial waste waters are included. (See also W80-00098 thru W80-00115) (Lisk-FRC) W80-00097

**OVERVIEW OF PHYSICAL-CHEMICAL TREATMENT.**  
J. M. Cohen, and J. J. Westrick.  
In: 2nd USA/USSR Symposium on Physical/

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

Chemical treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 4-13, 1975. 8 fig, 8 tab, 24 ref.

Descriptors: \*Lime, \*Activated carbon, Biological treatment, \*Chemical reactions, \*Filtration, Suspended solids, Municipal wastes, Waste water treatment.

The methods of physical-chemical treatment of municipal waste water are reviewed. Chemical clarification, in which the waste water is mixed with chemicals in a rapid mix basin followed by gentle stirring in a basin for a retention time of 10-15 min, includes one or more of the following: lime, salts of iron and aluminum, and organic polymers. Clarification reduces organic matter, suspended solids, and phosphates by 70-98%. Suspended solids remaining in effluents following physical-chemical treatment may be removed by granulated media filtration, especially granular activated carbon filtration. A model for maximizing carbon utilization is described and biological activity and carbon regeneration are reviewed. Powdered activated carbon systems are evaluated and their utilization and regeneration are described. The application and performance of physical-chemical treatment systems are reviewed. (See also W80-00097) (Lisk-FRC) W80-00098

#### STUDIES ON WASTEWATER TREATMENT WITH FLOCCULANTS APPLICATION,

I. N. Maysnikov, L. V. Gandurina, and I. N. Butzeva.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 14-19, 1975. 6 tab.

Descriptors: \*Flocculation, \*Coagulation, \*Minerals, \*Polyelectrolytes, \*Sewage treatment, Oily water, Chemical oxygen demand, Suspended solids, Separation techniques, Waste water treatment, Municipal wastes.

A study of waste water treatments with the application of flocculants and their combinations with mineral coagulants was performed with chemical, petroleum chemical, and pulp and paper effluents. The separation of solids and liquids by settling, filtration and compression flotation, and a study of water soluble cationic flocculants were performed. The coagulants studied included aluminum sulfate and the polyelectrolytes of highly molecular pyridine salts on a vinylpyridine base. Thus, sewage with a COD of 558 mg/liter, 64 mg/liter of suspended solids, and 40.8 mg/liter of oil products were reduced by 80%, 93.2%, and 73%, respectively. The use of 50 mg/liter of aluminum sulfate and 2 mg/liter flocculant was considered feasible. Coagulated waste water treatment tests were also tested with settling and compression settling. Polyelectrolyte treatment of sewage with different compositions was considered suitable despite the higher costs. Coagulant dosages of 2-10 mg/liter resulted in increased sewage treatment rates; the optimum sulfate aluminum content was considered to be 10 mg/liter. (See also W80-00097) (Lisk-FRC) W80-00099

#### THE OPERATION OF THE PHYSICAL-CHEMICAL PLANT AT ROSEMOUNT, MINNESOTA,

R. Polta.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 20-30, 1975. 10 fig, 5 tab, 2 ref.

Descriptors: \*Tertiary treatment, \*Treatment facilities, \*Activated carbon, \*Ion exchange, \*Lime, Chlorine, Suspended solids, Ammonia, Zeolites, Filters, Phosphorus, Waste water treatment, Municipal wastes.

Physical/chemical treatment was selected for a 0.6 mgd municipal waste water treatment plant constructed in Rosemount, Minnesota. The advanced treatment plant incorporates contact clarification,

two dual media filters for suspended solids removal, three granular activated carbon columns for soluble organics removal, two secondary dual media filters, and clinoptilolite ion exchange columns for ammonia nitrogen removal. Off line processes include the chemical feed systems which supply lime, ferric chloride, polymer, and chlorine, the activated carbon regeneration system, and the zeolite regeneration system for the ion exchange column. The advanced treatment plant reduces suspended solids to 5 mg/liter, BOD to 10 mg/liter, and total phosphorus to 1 mg/liter. (See also W80-00097) (Lisk-FRC) W80-00100

#### TREATMENT OF CHEMICAL PLANT EFFLUENTS,

M. N. Levchenko.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 31-34, 1975.

Descriptors: \*Chemical wastes, \*Chemical industry, \*Sewage treatment, \*Industrial water, \*Recirculated water, Biological treatment, Filtration, Recycling, Industrial wastes, Municipal wastes, Waste water treatment, Water reuse.

Chemical plants in the USSR providing biochemical treatment of combined industrial and municipal effluents and reuse of treated effluents as process water are reviewed. Industrial and sewage effluents are treated at a 100,000 cu m/day plant with biological and mechanical treatment followed by treatment in buffer ponds prior to ozonation and recycling of the treated water to the industrial process. A synthetic fiber plant has a treatment capacity of 80,000 cu m/day where effluents receive biological treatment followed by three-step cascade bioponds; effluents are recycled to the process water. A nitrogen plant further treats biologically treated effluents with a two-step filter system incorporating filter cloth filters and sand filters. Waste waters unfit for recycling are classified as: organic polluted, mineral polluted containing > 3 g/liter or < 3 g/liter, and sewage. Mineral polluted water with > 3 g/liter is treated with 7-step evaporation in vertical film-type vessels; water with less than 3 g/liter mineral content is treated in buffer ponds. Sewage and organic polluted waste water receive biological and mechanical treatment followed by buffer pond treatment. Further treatment of buffer pond effluent is described. Water supply routes at chemical plants are also described. (See also W80-00097) (Lisk-FRC) W80-00101

#### THE ROLE OF ACTIVATED CARBON IN PHYSICO-CHEMICAL TREATMENT,

Michigan Univ., Ann Arbor. Coll. of Engineering. W. J. Weber.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 35-49, 1975. 4 fig, 5 tab, 21 ref.

Descriptors: \*Activated carbon, \*Physical properties, \*Chemical properties, \*Surfaces, \*Adsorption, Porosity, Waste water treatment, Industrial wastes, Municipal wastes, Granules, Particle size.

The various properties and uses of activated carbon for the physical-chemical treatment of wastes are examined. Activated carbon may be prepared by the carbonization of vegetable substances impregnated with metallic chlorides or by the activation of charcoal with carbon dioxide and steam at high temperatures. Porosity is generated by the action of dehydrating chemicals or by the action of oxidizing gases evolved in the process. The surface area of activated carbon usually ranges from 430-1500 sq m/g, except bone charcoal which has about 100 sq m/g surface area. Methods of measuring the physical properties of activated carbon are reviewed. The type of reactor system for contacting the carbon with the waste water is of particular significance in large-scale treatment systems. The various types of contact processes and reactors are illustrated and described. The types of systems for the activated

carbon treatment of municipal and industrial waste waters are reviewed, and the operating results from several pilot physicochemical treatment plants are provided. Thermal regeneration of activated carbon is discussed. (See also W80-00097) (Lisk-FRC) W80-00102

#### THE REMOVAL OF VOLATILE SUSPENDED SOLIDS FROM WASTEWATERS,

I. N. Miasnikov, and B. A. Balakin.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 50-57, 1975. 3 fig, 1 tab.

Descriptors: \*Gases, \*Volatility, \*Nozzles, \*Evaporation, \*Spraying, Hydrogen sulfide, Chemical wastes, Pulp wastes, Waste water treatment, Industrial wastes.

Apparatuses for the degassing of waste waters are described and evaluated. Natural degassing through the use of open water surfaces at treatment facilities has an efficiency of 50-60%. Water blow-off with air in open channels and settling tanks results in blow-off products entering the atmosphere. Separate streams of waste waters and process solutions may be degassed with a chord nozzle; a nozzle of Raschig's rings, and hollow spraying desorbors. For abrasive industrial wastes, the use of the nozzle of Raschig's rings for degassing from hydrogen sulfide is about 95%; nozzle-type and cascade-type apparatuses are also suitable for removing hydrogen sulfide, mercaptan, dimethyl sulfide, and dimethyl disulfide from pulp and paper waste waters. Boiling is used for liquid wastes; chlorination also removes certain organic contaminants. Desorption in the nozzle-type apparatus of Raschig's rings, in the apparatus with a barbotage layer of liquid, and in spraying apparatuses is described in detail. (See also W80-00097) (Lisk-FRC) W80-00103

#### DESIGN OF FACILITIES FOR PHYSICAL-CHEMICAL TREATMENT OF RAW WASTEWATER,

G. L. Culp.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 58-75, 1975. 7 fig, 6 tab, 15 ref.

Descriptors: \*Coagulation, \*Adsorption, \*Activated carbon, \*Design criteria, \*Treatment facilities, Filtration, Polymers, Lime, Flocculation, Wastewater treatment, Municipal wastes.

Design parameters for the unit processes in the physical-chemical treatment of raw wastes, design criteria for specific waste water characteristics, criteria utilized for full-scale plants, and data from actual plants are presented. The coagulants reviewed include polymers, iron salts, aluminum salts, and lime; a comparative evaluation indicated that lime coagulation was the most economical method. Powdered carbon and column tests were performed to evaluate carbon adsorption treatment. Design criteria necessary for plant design are discussed and include flow, preliminary treatment, chemical feed, rapid mix, and flocculation, clarifier sizing, recarbonation, filtration, granular carbon adsorption, and carbon regeneration. Five alternative systems utilizing physical-chemical treatment of waste water are reviewed. Ten major installations utilizing physical-chemical treatment of raw waste water are listed. (See also W80-00097) (Lisk-FRC) W80-00104

#### SYNTHESIS OF CATIONIC POLYELECTROLYTES FOR TREATMENT OF NATURAL AND WASTE WATERS,

V. V. Korshak, L. B. Zubakova, and L. B. Gandurina.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 76-80, 1975. 2 fig, 6 tab, 3 ref.

## Waste Treatment Processes—Group 5D

Descriptors: \*Polymers, \*Polyelectrolytes, \*Cations, \*Salts, \*Flocculation, Waste water treatment, Acids, Organic compounds, Oil wastes, Industrial wastes.

The synthesis of cationic polyelectrolytes by polymer similar transformation of polymerization and polycondensation linear polymers or polymerization of nonlimitive inorganic monomers is reviewed. Quaternary vinylpyridine salts (QVPS) on vinylpyridine are used for the synthesis of highly basic water soluble polyelectrolytes. The polymerization of vinylpyridine salts was performed by spontaneous QVPS polymerization in concentrated water solutions by specific ion mechanisms, by radical QVPS polymerization in water ethanol solutions, or by radical QVPS polymerization without their intermediate isolation. The electroconductivity of water solutions of QVPS and polyelectrolytes (HPS-flocculants) at their base concentration of 0.015 mole/liter were compared. Cationic polyelectrolytes based on vinylpyridines were considered suitable for industrial waste water treatment but highly molecular polyvinylpyridine salts obtained by spontaneous polymerization of QVPS were the most effective flocculants. The utilization of HPS-II flocculant with a molecular weight of 700,000 treats waste waters containing acid dyes, petroleum products, dissolved and emulsified organic substances with an efficiency of 95-100%. (See also W80-00097) (Lisk-FRC) W80-00105

**PHYSICAL-CHEMICAL TREATMENT OF WASTEWATERS FROM THE PETROLEUM REFINING-PETROCHEMICAL INDUSTRY.** Environmental Protection Agency, Washington, DC, Office of Research and Development. W. J. Lacy, and A. Cywin. In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 81-89, 1975. 1 fig, 9 tab, 24 ref.

Descriptors: \*Oil industry, \*Oil wastes, \*Oily water, \*Research and development, \*Grants, Pollutant identification, Biochemical oxygen demand, Chemical oxygen demand, Waste water treatment, Industrial wastes.

The characteristics of waste waters from the petroleum refining and petrochemical industries are examined prior to a review of current treatment technology and research and demonstration grant programs. Ideal industrial waste treatment processes should effectively remove pollutants at a minimum cost, economically recover by-products, recycle recovered products and water to the process operation, require simple and minimum operating labor, and require low capital cost. Waste waters typically contain an average of 1,150 mg/liter BOD and 3,100 mg/liter COD. Oil refinery treatment processes include API separator, clarifier, dissolved air, flotation, filter, oxidation pond, aerated lagoon, activated sludge, trickling filter, cooling tower, activated carbon, granular media, and activated carbon processes. The efficiencies of these processes for removing BOD, COD, total organic carbon, suspended solids, oil, phenol, ammonia, and sulfide are provided. The need for research, development, and demonstration of biological oxidation, sludge disposal, advanced treatment, closed loop systems, and comprehensive approaches to treatment of waste waters is reviewed. Organizations having grants for the research and development of pollution control in the petroleum refining and petrochemical industry are cited. (See also W80-00097) (Lisk-FRC) W80-00106

**EXAMINATION OF OIL-CONTAINING WASTE WATERS CHEMICAL COMPOSITION AFTER THEIR TREATMENT IN AERATION TANKS.** For primary bibliographic entry see Field 5A. W80-00107

**COMPARISON OF ALTERNATIVE STRATEGIES FOR COKE PLANT WASTEWATER DISPOSAL.**

R. W. Dunlap, and F. C. McMichael.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 96-104, 1975. 7 fig, 7 tab, 7 ref.

Descriptors: \*Ammonia, \*Phenols, \*Cooling water, \*Biological treatment, \*Chemical reactions, Separation techniques, Recycling, Quenching, Water reuse, Waste water treatment, Industrial wastes.

Waste waters from coke plants are generated from tar still waste water, excess or waste ammonia liquor (WAL) from the primary cooler, ammonia absorber and crystallizer blowdown, final cooler waste water blowdown, light oil plant waste water, and gas desulfurization and cyanide stripper waste water. The practice of quenching with coke plant effluents rather than discharging them was recommended, regardless of the level of treatment. Tight rather than loose recycle of cooling waters was preferred. Level I treatment consists of physical-chemical systems of cyanide stripping, ammonia removal with a conventional still, and phenol extraction. Level II combines physical-chemical treatment with biological waste treatment. For recycling of cooling waters for quenching, no treatment is preferred, while Level I is preferred when waste waters are discharged. (See also W80-00097) (Lisk-FRC) W80-00108

**STUDIES ON OXIDATION PROCESSES OF CYANIDES AND PHENOLS IN WASTE AND NATURAL WATERS BY USING CHLORINE DIOXIDE.**

A. N. Belevtzev, and Ju. L. Maximenko.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 105-110, 1975. 9 fig.

Descriptors: \*Phenols, \*Chlorine dioxide, \*Oxidation, \*Oil industry, \*Organic compounds, Chemical oxygen demand, Chemical reactions, Oil wastes, Waste water treatment, Industrial wastes.

The use of chlorine dioxide as an alternative to hypochlorite, chlorine, and chloride of lime in the treatment of cyanides and phenols in industrial waste and natural waters was examined. Chlorine dioxide was evaluated over other oxidizing agents because of its relative stability in water solutions and its high oxidation potential. Tests were performed for the oxidation of simple and complex cyanides, rhodanides, sulfides, and phenols. The chemical reactions occurring during the oxidation of phenols and cyanides by chlorine dioxide are reviewed, and the effects of pH, temperature, and pollutant concentration on the oxidation process are presented. COD was reduced by 90-95% with a chlorine dioxide dose of 5-8 mg/l mg of COD removed. Phenols in the concentration range of 0.1-1 mg/liter in biochemically treated refinery effluents were effectively oxidized with a chlorine dioxide dose of 5 mg/liter over a 10-15 min period. (See also W80-00097) (Lisk-FRC) W80-00109

**TREATMENT OF CONCENTRATED WASTE WATERS CONTAINING OIL EMULSIONS.** V. G. Ponomarev, and S. B. Zakharina.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 120-123, 1975. 3 fig.

Descriptors: \*Oily water, \*Emulsions, \*Separation techniques, \*Settling basins, \*Filtration, Sludge treatment, Flotation, Suspended solids, Waste water treatment, Industrial wastes.

A system of treating and regenerating waste waters containing oil emulsions is presented. From bench-scale and industrial tests, the treatment system incorporates settling to separate oil and suspended solids, filtration, treatment in a settling-reacting tank where hydrogen sulfide odors are treated with  $\text{KMnO}_4$ , sodium nitrate, and hexachlorophene, passage of suspended materials to a

sludge holding tank and oil to an oil collector, and feeding of the sludge to filter presses for dehydration. Pressure flotation with the application of aluminum sulfate, ferrous sulfate, ferrous chloride, or sulfuric acid was also evaluated. Centrifugation and hyperfiltration were also investigated. (See also W80-00097) (Lisk-FRC) W80-00111

**ADVANCED WASTEWATER TREATMENT FOR AN ORGANIC CHEMICALS MANUFACTURING COMPLEX.**

A. C. Marek, and W. Askins.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 124-135, 1975. 10 fig, 7 tab.

Descriptors: \*Chemical wastes, \*Chemical industry, \*Activated carbon, \*Filtration, \*Dyes, Pilot plants, Laboratory tests, Coals, Sands, Adsorption, Waste water treatment, Tertiary treatment, Industrial wastes.

The waste water treatment system for effluents from the American Cyanamid Company, a manufacturer of dyes, chemical intermediates, organic pigments, plastic additives, pharmaceuticals, fine chemicals, agricultural chemicals, elastomers, and rubber chemicals is reviewed. An advanced waste water treat is under design for treating the effluent which already receives primary and secondary treatment. Research and laboratory bench scale studies of various treatment processes indicated that trimedia filtration and carbon adsorption was the preferred treatment system. The trimedia filter contained layers of coal, sand, and garnet. Pilot plant studies and prototype systems were operated to test the processes and a full-scale system is under design from the results. (See also W80-00097) (Lisk-FRC) W80-00112

**COST BENEFITS OF PHYSICAL CHEMICAL TREATMENT.**

F. P. Sebastian.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 136-143, 1975. 5 fig, 5 tab, 11 ref.

Descriptors: Treatment facilities, \*Cost-benefit analysis, \*Economics, \*Polychlorinated biphenyls, \*Pesticides, Biological treatment, Chemical reactions, Waste water treatment, Municipal wastes.

The suitability and cost benefits of utilizing independent physical chemical treatment (IPCT) systems for treating waste waters were examined. IPCT systems are considered economically competitive with biological treatment systems for complying with the 1977 mandate for best practicable control technology. These systems may also be more economically upgraded to the 1983 standard of best available technology than the addition of tertiary treatment to biological plants. IPCT systems effectively control polychlorinated biphenyls, pesticides, and heavy metals and produces ash product-fertilizer. Energy may be reclaimed from the sludge and particulate emissions meet EPA air pollution standards. (See also W80-00097) (Lisk-FRC) W80-00113

**PROCESSING AND NEUTRALIZATION OF INDUSTRIAL WASTES FROM IRON AND STEEL EFFLUENTS TREATMENT.**

O. P. Ostrovsky, U. M. Souproun, and U. N. Reznikov.

In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975, p 144-149, 1975. 2 tab.

Descriptors: \*Sludge treatment, \*Steel, \*Iron, \*Dewatering, \*Neutralization, Burning, Minerals, Filtration, Centrifugation, Desalination processes, Waste treatment, Waste water treatment, Industrial wastes.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

The treatment and utilization of sludges from iron and steel processing plants are reviewed. Iron-bearing and gypsum-bearing sludges comprise the larger portion of the wastes from these plants. Sludges are produced from sintering plants, stock houses of blast furnace shops, gas cleaning installations of blast furnaces, converter, open hearth furnaces, and electric melting furnaces, mill scale, desulfurization, neutralized sulfuric acid wastes, and other sources. High-mineralized waste waters and organic wastes are also generated. Certain sludges are utilized for other purposes and processes and dewatering units include classifiers, vacuum filters, press filters, and centrifuges. The three basic process flow diagrams are for multisized sludge dewatering, for dewatering of monodispersed sludge of intermediate size, and for highly dispersed sludge dewatering. High mineralized wastes are dewatered with thermal desalting and organic wastes are neutralized with a flame method using cyclone furnaces. (See also W80-00097) (Lisk-FRC) W80-00114

#### FUNDAMENTAL PRINCIPLES OF SELECTING THE METHOD FOR PROCESSING SEWAGE SEDIMENTS IN ACCORDANCE WITH THEIR PROPERTIES.

N. A. Lukinykh, and I. S. Turovsky.  
In: 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Cincinnati, Ohio, November 12-14, 1975. p 150-153, 1975. 3 fig, 4 ref.

Descriptors: \*Sewage sludge, \*Dewatering, \*Sludge treatment, \*Mathematical models, \*Analytical techniques, Filters, Centrifugation, Biological treatment, Waste water treatment, Municipal wastes.

Methods of treating sediments resulting from the treatment of sewage include fermentation in anaerobic and aerobic conditions, drying on silt pads and ponds, dehydration on vacuum filters, centrifuges, filter presses, and other devices, and decontamination by thermal treatment or incineration. The specific resistance of the filtration sediment, the centrifuging index, and the position of the first critical humidity point were found to control the characteristics of sewage sediment dewatering. Methods were developed for determining the appropriate sediment treatment method and the degree of readiness of the sediment for mechanical dewatering. Gas suspension counter-currents combined with an air fountain regime was found to be the most efficient method of thermal drying of dewatered sewage sediments. (See also W80-00097) (Lisk-FRC) W80-00115

#### PROCEEDINGS OF THE 8TH NATIONAL SYMPOSIUM ON FOOD PROCESSING WASTES, MARCH 30-APRIL 1, 1977, SEATTLE, WASHINGTON.

Report EPA-600/2-77-184, August 1977, 442 p.

Descriptors: \*Food processing industry, \*Waste treatment, \*Industrial wastes, Byproducts, Water reuse.

Twenty-eight papers were presented on various topics dealing with the treatment or elimination of food processing wastes. The following topics are included: processing modifications, product and byproduct recovery, waste water treatment, water recycle, and water reuse for several segments of the food processing industry. Industry segments include red meat and poultry, seafood, dairy, fruit, and vegetable. About 200 representatives of industry, universities, consulting firms, and government attended the two day symposium. (See W80-00117 thru W80-00144) (Small-FRC) W80-00116

STATUS OF EPA'S EFFLUENT GUIDELINES FOR THE FOOD INDUSTRY, Environmental Protection Agency, Washington, DC. Effluent Guidelines Div. For primary bibliographic entry see Field 6E. W80-00117

#### EFFLUENT POLISHING AND WASTEWATER REUSE AT SNOOKIST GROWERS CANNERY, Esvelt Environmental Engineering, Spokane, WA. L. A. Esvelt, and H. H. Hart.

In: Proceedings of 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 20-37, 1977. 6 fig, 5 tab, 3 ref.

Descriptors: \*Food processing industry, \*Water reuse, \*Activated sludge, \*Filtration, \*Chlorination, Recycling, Waste water treatment, Industrial water.

The feasibility of fruit wastewater reuse was investigated including documentation of the reduction of pollutants being discharged resulting from the reuse of process waters and the economics involved. Facilities for biological effluent polishing were installed and monitored. The reclaimed water was used for equipment cleaning, product cleaning, steam production, and cooling. The polishing system consists of mixed media filtration and chlorination, and the biological treatment system is an activated sludge type. The reclaimed water was of consistent quality for use in the areas investigated. The reuse of water during the 1976 process season resulted in approximately 35% reduction in waste water discharged. Projections for full scale cooling use indicate an effluent reduction of 50% or greater. (See also W80-00116) (Small-FRC) W80-00118

#### CONTROL OF ODORS FROM AN ANAEROBIC LAGOON TREATING MEAT PACKING WASTES,

Texas Amarillo Systems Co.  
J. A. Chittenden, L. E. Orsi, J. L. Witherow, and W. J. Wells.

In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 38-61, 1977. 6 fig, 12 tab, 15 ref.

Descriptors: \*Hydrogen sulfide, \*Odor, \*Anaerobic digestion, \*Food processing wastes, \*Membranes, Chlorination, Costs, Incineration.

The control of hydrogen sulfide emissions from anaerobic lagoons treating meat packing wastes is reviewed. Lagoons which treat waste water containing 100 mg/liter or more of sulfate require odor control. Odor emissions can be reduced by designing submerged inlets and outlets, operations to maintain a complete scum cover, chlorination of the raw waste water prior to transport by pipeline, and changing to a water supply with lower sulfate levels. A flexible membrane cover and positive gas removal system can also control odor emissions. Even with the added cost of control equipment, anaerobic lagoons are less expensive than aerobic treatment for meat packing wastes. The odorous gas can be incinerated or used in a dedicated boiler for the production of steam. (See also W80-00116) (Small-FRC) W80-00119

#### TOMATO CLEANING, WATER RECYCLE AND MUD DEWATERING,

National Canners Association, Berkeley, CA.

W. W. Rose.

In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 62-75, 1977. 2 fig, 4 tab, 5 ref.

Descriptors: \*Food processing industry, \*Dewatering, \*Industrial water, \*Mud, \*Industrial wastes, Performance, Costs, Tomatoes, Waste water treatment, Water reuse.

The problem of cleaning mechanically harvested tomatoes with less water, the removal of mud from the dump tank, and the development of a water recycle system, were investigated. Mechanical energy in the form of rotating rubber discs used a minimum of water and cleaned the tomatoes adequately. Physical and chemical treatment was applied to the dump tank water and the water was recycled back to the dump tank. Dewatering of mud by a horizontal vacuum belt was investigated.

The dewatering system consisted of: a sludge receiving hopper, a vacuum belt with variable speed chain drive, a vacuum source and filtrate withdrawal pump, and filter cake removal and belt cleaning units. Dewatering efficiency was between 17 and 70% with an average of 37%. The drying factor ranged from 1.21 to 1.89 with an average of 1.53. Sludge volume reduction efficiencies ranged from 17 to 49%, and solids recovery efficiencies ranged from 91 to 99%. The dewatering unit cost \$2 per ton of dry solids. (See also W80-00116) (Small-FRC) W80-00120

#### REMOVAL OF SUSPENDED SOLIDS AND ALGAE FROM AEROBIC LAGOON EFFLUENT TO MEET PROPOSED 1983 DISCHARGE STANDARDS TO STREAMS,

Swift and Co., Oak Brook, IL.

E. R. Ramirez, D. L. Johnson, and T. E. Elliott.

In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 76-84, 1977. 5 fig, 4 tab, 10 ref.

Descriptors: \*Algae control, \*Coagulation, \*Costs, \*Food processing wastes, \*Suspended solids, Standards, Regulation, Aerobic conditions, Waste water treatment.

A process which combines electrocoagulation with a specially designed dissolved air flotation basin was developed for the removal of suspended solids and algae from aerobic lagoon effluent. The process was developed to meet the needs of a hog packing plant which processes about 2000 hogs per day. The plant was experiencing difficulty in meeting effluent standards due to the growth of algae in aerobic lagoons. A Lactoclear system was installed which can meet both 1977 and 1983 effluent standards by increasing the amount of metal coagulant employed. The system first destabilizes the hydrophilic biocolloid and recycle dissolved air flotation removes the last traces of suspended material from the waste water. Annual operating and maintenance costs based on a design of 1500 gallons per minute was an estimated maximum of \$75,000 per year. Annual fixed costs and depreciation costs were estimated at \$25,000. (See also W80-00116) (Small-FRC) W80-00121

#### EFFLUENT GENERATION, ENERGY USE AND COST OF BLANCHING,

Science and Education Administration, Albany, CA. Western Regional Research Center.

J. L. Bomben.

In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 85-97, 1977. 2 fig, 9 tab, 12 ref.

Descriptors: \*Food processing wastes, \*Industrial water, \*Cost, \*Vegetable crops, Industrial wastes, Efficiencies, Mechanical equipment.

The characteristics of conventional blanchers and new blancher designs, and the effluent generation and energy use of blanchers are discussed. Also, the cost of blanching with four different blanchers was investigated. Water blanching had the highest hydraulic waste load, but because of its low capital investment it costs significantly less than other blanching methods. The Vibratory Spiral Blancher had a higher steam efficiency than other blanchers, and when combined with a Vibratory Spiral Cooler, it generated less wastewater than the other techniques with the exception of Hot-Gas Blanching. The hydrostatic steam blancher had a much higher steam efficiency than conventional steam blanchers, but its efficiency was less than that of the Vibratory Spiral Blancher or a water blancher. Because frozen vegetables are sold by weight, yield loss from air cooling is a significant economic penalty. (See also W80-00116) (Small-FRC) W80-00122

#### DISSOLVED AIR FLOTATION TREATMENT OF SEAFOOD PROCESSING WASTES - AN ASSESSMENT,

## Waste Treatment Processes—Group 5D

a sludge re-  
variable speed  
filtrate with-  
val and belt  
was between  
The drying  
an average of  
encies ranged  
y efficiencies  
ring unit cost  
W80-00116)

Jordan (Edward C.), Inc., Portland, ME.  
D. B. Ertz, J. S. Atwell, and E. H. Forsht.  
In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 98-118, 1977. 3 fig, 14 tab,  
10 ref.

Descriptors: \*Food processing industry, \*Flota-  
tion, \*Industrial water, Design criteria, Suspended  
solids, Dewatering, Waste disposal, Optimization.

The dissolved air flotation method is being used by  
large tuna canners in San Diego, Puerto Rico,  
American Samoa, and Terminal Island for the  
treatment of seafood processing waste waters.  
Facilities were monitored and found to generally  
meet design criteria for overflow rate, solids load-  
ings, air to solids ratio, hydraulic retention time,  
and the ability to maintain the appropriate pH  
level. Optimum criteria are: overflow rate 2 gpm/  
sq ft, solids loading 1 lb/hour/sq ft, air to solids  
ratio 0.01-0.04, and hydraulic retention time of 1  
hour. The handling and disposal of residuals is a  
problem. One tuna processor dewateres the resid-  
uals by centrifugation, but by-product recovery has  
not been implemented on a full scale. (See also  
W80-00116) (Small-FRC)  
W80-00123

**COMMERCIAL FEASIBILITY OF RECOVER-  
ING TOMATO PEELING RESIDUALS,**  
Science and Education Administration, Albany,  
CA. Western Regional Research Center.  
W. G. Schultz, H. J. Neumann, J. E. Schade, J. P.  
Morgan, and P. F. Hanni.  
In: Proceedings of 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 119-136, 1977. 3 fig, 2 tab,  
22 ref.

Descriptors: \*Food processing industry, \*Indus-  
trial wastes, \*Byproducts, \*Acidic water, Waste  
water treatment, Industrial water, Separation tech-  
niques, Water pollution sources.

A two year project to investigate the feasibility of  
recovering tomato peeling residues for food use is  
described. During the first year, peel was pro-  
cessed through a 20 gpm continuous flow line  
which consisted of acidifying the peel to pH 4.2  
with food-grade hydrochloric acid, then separating  
the pulp from the skin with a paddle finisher. The  
recovered pulp was of food quality but contained  
large amounts of peeling-aid residues. Peeling aids  
are approved for peeling but not as additives to the  
final product. During the second year modifications  
of the peeling process were studied. The tomatoes  
were pretreated by immersion in a 150 F  
aqueous bath containing about 0.15% food-grade  
octanoic acid. Recovered pulp met USDA quality  
Grade A, and the octanoic acid levels were gen-  
erally low (30 ppm). (See also W80-00116) (Small-  
FRC)  
W80-00124

**APPLICATION OF FINE SCREENS IN THE  
TREATMENT OF FOOD PROCESSING  
WASTEWATER,**  
C-E Bauer, Springfield, OH.

R. Neal, R. Chaney, and A. Bubp.  
In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 147-154, 1977. 1 fig, 2 tab.

Descriptors: \*Screens, \*Suspended solids, \*Food  
processing industry, \*Waste water treatment,  
\*Economics, Maintenance, Performance, Byprod-  
ucts.

Fine screens are the most common pretreatment  
device in the food processing industry for process  
waste waters. The static fine screen is described  
which is widely used for solids removal because of  
its effectiveness, simplicity, and economy. It is  
particularly useful for applications where minimum  
maintenance is required. The use of fine screens is  
reviewed for the following industries: vegetable  
and food processing, meat packing, dairy, poultry  
growing and processing, seafood processing, and  
brewery, distillery, and wine. Rapid return on in-  
vestment has been experienced by many food pro-

cessors after the installation of static screens due to  
reduced sewer surcharges or byproduct recovery.  
(See also W80-00116) (Small-FRC)  
W80-00126

**REUSE OF BRINES IN COMMERCIAL CU-  
CUMBER FERMENTATIONS,**  
Michigan State Univ., East Lansing. Dept. of Food  
Science and Human Nutrition.  
R. F. McFeeters, M. P. Palnikar, M. Velting, N.  
Fehring, and W. Coon.  
In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 169-185, 1977. 1 fig, 16 tab,  
8 ref.

Descriptors: \*Food processing industry, \*Fermen-  
tation, \*Vegetable crops, \*Water reuse, \*Brines,  
Recycling, Industrial water, Disinfection, Econo-  
mics, Performance.

Recycling procedures for cucumber fermentation  
brines were investigated as means of minimizing  
the waste water produced. Chemical and pasturiza-  
tion procedures were compared as methods of  
eliminating pectinase activity in the recycled brine.  
The use of fermentation brines for three cycles  
showed no differences between fermentations in  
recycled brines and those carried out in control  
brines. Differences were observed in pH, titratable  
acidity, and time of fermentation. The two treat-  
ment methods were equally successful. Pasturiza-  
tion allows about 95% recovery of brine. Chemical  
treatment results in a somewhat higher loss of  
brine, but a recovery of 90% is feasible. Chemical  
treatment did degrade pesticide residues while pas-  
turization did not. A small net savings is realized  
with pasturization. (See also W80-00116) (Small-  
FRC)  
W80-00128

**TREATMENT OF PACKINGHOUSE  
WASTEWATER BY SAND FILTRATION,**  
East Central Oklahoma State Univ., Ada. School  
of Environmental Science.  
M. L. Rowe.

In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 186-196, 1977. 1 fig, 4 tab,  
10 ref.

Descriptors: \*Food processing industry, \*Filtration,  
\*Pilot plants, \*Performance, \*Costs, Mainte-  
nance, Operations, Biochemical oxygen demand,  
Coliforms, Treatment facilities, Regulation.

The treatment of meatpacking waste water by  
intermittent sand filtration was evaluated at the W.  
E. Reeves Packing Company in Ada, Oklahoma.  
Initially, two pilot scale units were used. Construc-  
tion and operation of the sand filters are described.  
During early stages of operation the facility re-  
quired a great deal of manpower for frequent filter  
unit cleanings. After filter media and hydraulic  
loading rates were modified, maintenance and  
operational problems became minimal. The facility's  
effluent met the 1977 effluent guidelines for all  
parameters with the exception of fecal coliforms.  
With the addition of a disinfection system, the  
facility could meet all guidelines. The 30-day aver-  
age and maximum day average values for the 1983  
limitations with respect to BOD-5 and the 30-day  
average value for suspended solids were exceeded  
slightly. The costs were estimated as follows:  
\$2000 for sewer and manholes, \$12,000 for ex-  
tended aeration lagoon, \$13,000 for sand filter, and  
\$500 for annual maintenance of filter. (See also  
W80-00116) (Small-FRC)  
W80-00129

**AN EFFECTIVE WASTEWATER MANAGE-  
MENT PROGRAM FOR A FOOD PROCESSOR,**  
Eutek, Inc., Sacramento, CA.  
G. E. Wilson, and J. Y. C. Huang.

In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 200-210, 1977. 1 fig, 4 tab.

Descriptors: \*Food processing industry, \*Carrots,  
\*Recycling, \*Suspended solids, \*Pilot plants,

Waste water treatment, Turbidity, Flocculation,  
Filtration, Biochemical oxygen demand, Industrial  
wastes.

A carrot processor, a direct discharger, installed a  
process waste water recycle and final effluent po-  
lishing system which meets the requirements of the  
National Pollutant Discharge Elimination System.  
First, soil solids removal and waste reuse systems  
were evaluated. A pilot system for suspended and  
colloidal solids was implemented which included: a  
chemical feeding pump and diffuser, decayed gra-  
dient flocculator, gravity sedimentation tank, and  
granular media filter. The full scale system utilized  
a decayed gradient flocculator/gravity clarifier  
and coarse media contact filtration. The turbidity,  
suspended solids, biochemical oxygen demand, and  
chemical oxygen demand of the treated water  
were 7-20 FTU, 10 to 30 mg/liter, 5 to 10 mg/liter,  
and 25 to 50 mg/liter, respectively. The discharge  
meets all requirements and is suitable for reuse.  
(See also W80-00116) (Small-FRC)  
W80-00130

**ECONOMIC RETURN ON POLLUTION CON-  
TROL EXPENDITURES FOR THE PICKLED  
FOOD INDUSTRY,**  
Johnson and Anderson, Inc., Pontiac, MI.  
J. G. Meehan.

In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 197-199, 1977.

Descriptors: \*Food processing industry, \*Chlor-  
ides, \*Filtration, \*Operation and maintenance, In-  
dustrial wastes, Pollution abatement, Waste water,  
Operations.

Approximately 35% of the water usage at plants  
which ferment, store, and pack pickled food could  
be reduced, and raw waste loading could be re-  
duced through improved housekeeping and screen-  
ing. Chlorides can also be reduced through elimi-  
nation of tank leakage and control of storm water  
runoff. In the cucumber pickling industry, chloride  
reductions can be realized by: proper pumping of  
cucumbers and pickles, degassing and recircula-  
tion of fermentation brine, and adjustment of  
fermentation brine constituents. Cost reduction  
features which also control pollution are: cluster-  
ing of tanks, permanently sealed tank tops, slicing  
of cucumbers and pickles to eliminate damaged  
stock, controlled fermentation, reuse of brine, and  
the elimination of forklift trucks, tote boxes, etc.  
(See also W80-00116) (Small-FRC)  
W80-00131

**RECOVERY OF SOLUBLE SERUM PROTEINS  
FROM MEAT INDUSTRY WASTES,**  
Washington State Dept. of Ecology, Olympia.  
R. W. Greiling.

In: Proceedings of the 8th National Symposium on  
Food Processing Wastes, March 30-April 1, 1977,  
Seattle, Washington, p 211-234, 1977. 8 fig, 5 tab, 8  
ref.

Descriptors: \*Food processing industry, \*Indus-  
trial wastes, \*Proteins, \*Byproducts, Hydrogen ion  
concentration, Coagulation, Performance, Econo-  
mics, Waste water treatment.

Laboratory investigations of methods for the re-  
covery of soluble serum proteins from slaughter-  
house wastes determined that dissolved serum pro-  
teins can be recovered economically through pH  
and temperature denaturation. An effective coag-  
ulant aid is the organic polymer chitosan. Dissolved  
proteins are removed most effectively when pH is  
at or below the isoelectric point. Also, a minimum  
operating temperature of 60 degrees C should be  
maintained for maximum recovery. Protein remov-  
al efficiency can be measured by organic nitrogen  
and is predicted by a six parameter model. The  
estimated net worth of the dried protein product  
plus cost savings from current treatment systems  
should be more than sufficient to amortize the  
required capital investment and cover preliminary  
cost estimates. (See also W80-00116) (Small-FRC)  
W80-00132

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

#### IMPROVED BIOLOGICAL TREATMENT OF FOOD PROCESSING WASTES WITH TWO-STAGE ABF PROCESS,

Neptune Microfloc, Inc., Corvallis, OR. B. W. Hemphill, and R. G. Dunnahoo. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 235-252, 1977. 7 fig, 5 tab, 10 ref.

Descriptors: \*Filtration, \*Food processing industry, \*Biological treatment, \*Microorganisms, Aeration, Performance, Waste water treatment, Industrial wastes.

Data from pilot scale studies and full scale plants using the activated bio-filtration (ABF) process for the treatment of food processing wastes, are presented and discussed. The process combines the advantages of both the fixed-film and suspended growth treatment systems and has a superior process stability. After primary treatment, the waste water is combined with sludge from the secondary clarifier and Bio-Cell recycle and pumped to the Bio-Cell. Fixed-film organisms attach to horizontal bio-media, and suspended growth organisms combine with the fixed-film to oxidize biodegradable organics. An aeration basin is usually employed. System design criteria are expressed in terms of Bio-Cell organic loadings and aeration basin loadings are expressed as System F/M. The energy-efficient fixed-film Bio-Cell realizes significant power savings. (See also W80-00116) (Small-FRC) W80-00133

#### SINGLE CELL PROTEIN FROM FOOD WASTES BY THE DEEP TANK PROCESS,

Idaho Univ., Moscow. Dept. of Chemical Engineering. M. L. Jackson, and C. C. Shen. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 253-265, 1977. 6 tab, 19 ref.

Descriptors: \*Food processing industry, \*Industrial wastes, \*Byproducts, \*Proteins, \*Potatoes, Aeration, Flotation, Costs.

The procedures for the production of single cell protein from food processing wastes using deep tank aeration-flotation for fermentation processing are reviewed. An economic estimate of the continuous conversion of 1.25 million gal/day of a potato waste and the sale of the single cell protein for animal feed, indicates that the income should almost double the production costs. The economics of producing single cell protein by batch processing indicates that tankage costs would be 2 to 3 times more than that for continuous flow. Also, capital costs would increase from 30 to 40%, while operating costs would remain unchanged. (See also W80-00116) (Small-FRC) W80-00134

#### EVALUATION OF INSTANT NOODLES PROCESSING WASTEWATER CHARACTERISTICS AND TREATMENT ALTERNATIVES,

Hawaii Univ. at Manoa, Honolulu. P. Y. Yang, and V. S. Luis. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 266-283, 1977. 12 fig, 2 tab, 2 ref.

Descriptors: \*Food processing industry, \*Industrial wastes, \*Biological treatment, \*Coagulation, Activated sludge, Aeration, Biochemical oxygen demand, Suspended solids.

Waste water characteristics and treatment alternatives were evaluated for an instant noodle processing plant producing waste water containing soap, grease, flour, and noodle strands. Treatment methods considered were: sedimentation/flotation, coagulation, and biological treatment. For optimum results, grease should be removed first, and a semi-continuous flow plant should be used. Sedimentation even with chemical coagulation is not recommended. Biological treatment is necessary because of the high BOD-5, COD, and volatile solids. The extended aeration activated sludge process with

prior grease removal is recommended. (See also W80-00116) (Small-FRC) W80-00135

#### POTATO JUICE PROCESSING,

Massachusetts Univ., Amherst. Dept. of Food and Agricultural Engineering. J. R. Rosenau, L. F. Whitney, and J. R. Haight. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 284-291, 1977. 2 fig, 14 ref.

Descriptors: \*Byproducts, \*Protein, \*Food processing industry, \*Potatoes, Waste treatment, Reverse osmosis, Costs, Drying.

A method for the production of animal feeds by potato juice processing is reviewed. Juice is heated quickly and centrifuged. The resulting protein sludge is about 20% solids and 70% crude protein. The sludge is spray dried as high protein meal. The remaining juice is concentrated to 15% solids by reverse osmosis followed by evaporation to 70% solids. These solids are then mixed with the pulp and dried. When an average of 400 ton of potatoes are processed each day by a staff of ten, the plant costs about \$2,000,000. There is about a 42% return on the investment. (See also W80-00116) (Small-FRC) W80-00136

#### RECOVERY AND APPLICATION OF ORGANIC WASTES FROM THE LOUISIANA SHRIMP CANNING INDUSTRY,

Louisiana State Univ., Baton Rouge. Dept. of Food Science. B. E. Perkins, and S. P. Meyers. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 292-307, 1977. 5 fig, 5 tab, 13 ref.

Descriptors: \*Food processing industry, \*Industrial wastes, \*Shrimp, \*Byproducts, \*Waste treatment, Proteins, Filtration, Carbon, Feeds.

Methods for the recovery and application of organic wastes from the Louisiana shrimp canning industry are reviewed. Wastes from Gulf canned and frozen shrimp amounted to 179.5 million lbs in 1976. Shrimp blanch water and raw shrimp processing water were analyzed. Screening of blanch water followed by chemical removal of dissolved protein and sugar resulted in an acceptable reduction in total carbon. Shrimp byproducts can be used in livestock feed, tropical fish/bird diets, aquaculture diets, pet food, and in fabricated shrimp products. (See also W80-00116) (Small-FRC) W80-00137

#### TOXICITY OF SOME CANADIAN FRUIT AND VEGETABLE PROCESSING EFFLUENTS,

Stanley Associates Engineering Ltd., Edmonton (Alberta). A. Lamb, C. W. Fulton, and P. Mulyk. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 308-321, 1977. 1 fig, 5 tab.

Descriptors: \*Toxicity, \*Food processing industry, \*Industrial water, \*Bioassay, \*Sweet corn, Fish, Biochemical oxygen demand, Suspended solids, Nitrogen, Waste water treatment.

Waste water toxicity in the fruit and vegetable processing industry is reviewed for 221 Canadian plants. Total potential raw waste water BOD-5 varies from 0.82 times 10 to the 6th power to 12.02 times 10 to the 6th power kg and suspended solids varies from 0.30 times 10 to the 6th power to 2.99 times 10 to the 6th power kg. Existing treatment systems remove 76.2% of total BOD-5 and 79.8% of total suspended solids. Bioassay tests involving operations of fish mortality determined that raw screened waste waters from tomato, corn, beet, apple, plum, broccoli, and jam processing operations were toxic. Treated effluent from corn processing was toxic while other treated effluents demonstrated no toxicity. The high organic nitrogen

content of corn processing effluents may contribute to toxicity. (See also W80-00116) (Small-FRC) W80-00138

#### REDUCTION OF WASTES FROM CUCUMBER PICKLE PROCESSING BY USE OF THE CONTROLLED CULTURE FERMENTATION PROCESS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering. L. W. Little, R. Harrison, J. Davis, J. Harris, and S. J. Dunn. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 322-332, 1977. 3 fig, 2 tab, 6 ref.

Descriptors: \*Food processing industry, \*Fermentation, \*Industrial wastes, \*Brines, \*Salts, Industrial water.

A commercial demonstration project using the controlled culture fermentation procedure (CCF) was evaluated for waste reduction in the cucumber pickling industry. Using this procedure, cucumbers are sanitized by a chlorine wash and the brine is inoculated with rapid-growing lactic acid bacteria. CCF fermentations are more rapid and result in higher levels of acidity than do natural fermentations. A brinestock of superior quality is produced, and the amount of salt to be discharged is reduced. Whole dill pickles produced by CCF are equal in taste and superior in appearance and texture to naturally fermented dills. Hamburger chips from the two processes are similar. (See also W80-00116) (Small-FRC) W80-00139

#### SALMON PROCESSING WASTEWATER TREATMENT,

Kramer, Chin, and Mayo, Inc., Seattle, WA. P. A. Bissonnette, S. S. Lin, and P. B. Liao. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 333-354, 1977. 5 fig, 11 tab, 8 ref.

Descriptors: \*Food processing industry, \*Industrial wastes, \*Aeration, \*Salmon, Regulation, Performance, Treatment facilities, Regulation.

The extended aeration process of the Skokomish salmon processing plant was evaluated with respect to Environmental Protection Agency effluent limitation guidelines. Flow and pollutants generated per ton of fish processed for small salmon was greater than for large salmon. Unexpected flows resulted in long retention times and overaeration. Higher removal efficiencies for phosphorus during the processing of large fish resulted from longer retention times and overaeration which caused denitrification and phosphorus release in the aeration chamber. During plant shutdown, the addition of fish food maintained the performance of the treatment system. The plant produces effluent which meets EPA limits in terms of BOD, suspended solids, and grease/oil. (See also W80-00116) (Small-FRC) W80-00140

#### FUNGAL CONVERSION OF CARBOHYDRATE WASTES TO ANIMAL FEED PROTEIN-VITAMIN SUPPLEMENTS,

Denver Univ., CO. Dept. of Biological Sciences. B. D. Church, C. M. Widmer, and R. Espinosa. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 355-388, 1977. 10 fig, 7 tab, 32 ref.

Descriptors: \*Sweet corn, \*Food processing industry, \*Biochemical oxygen demand, \*Biological treatment, \*Industrial wastes, Waste treatment, Fermentation, Feeds.

A process was developed for the fungal conversion of corn wet-milling wastes to an animal feed protein-vitamin supplement which also reduced the BOD-5 level of the processing plant's waste. The fermentor is not described. A 10-20% fungal inocu-

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

lum level, a low pH of 4.0 to 4.5, selection of a rapid growing fungal strain, and the inoculation-dilution start-up procedure were required for maintenance of a near pure culture processing. Under optimum fermentation, the contaminant level rarely exceeded 200 microorganisms per ml. During equipment malfunction, *Geotrichum*, *Penicillium*, *Aspergillus*, and *Mucor* caused problems. Animal feeding trials were successful. (See also W80-00116) (Small-FRC) W80-00141

#### WATER REUSE OF WASTEWATER FROM A POULTRY PROCESSING PLANT,

Pittsburgh Univ., PA.  
J. B. Andelman, and J. D. Clise.  
In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 389-410, 1977. 1 fig, 9 tab, 10 ref.

Descriptors: \*Water reuse, \*Food processing industry, \*Poultry, \*Feasibility studies, Industrial water, Water quality, Aeration, Filtration, Flocculation, Chlorination, Standards.

A reclamation system was evaluated for poultry processing plant waste water with reference to technical and economic feasibility. The reclamation system consisted of aerated lagoons, followed by microstraining, flocculation and sedimentation, and filtration with two stages of chlorination. The renovated water was sampled extensively and neither salmonellae or enterobacteriaceae were isolated. Also, drug residues and avian viruses were not present in the reclaimed water or in the chicken carcasses. Organic and inorganic water quality analyses were performed. The reclaimed water met Environmental Protection Agency potable water standards. (See also W80-00116) (Small-FRC) W80-00142

#### WATER REUSE IN POULTRY PROCESSING: CASE STUDY IN EGYPT,

Alexandria Univ. (Egypt). Higher Inst. of Public Health.  
A. Hamza, S. Saad, and J. Witherow.  
In: Proceedings of the 8th National Conference on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 411-426, 1977. 7 fig, 6 tab, 10 ref.

Descriptors: \*Poultry, \*Food processing industry, \*Water reuse, \*Cooling water, Water quality, Industrial water, Water treatment.

Poultry and water characteristics during poultry processing were evaluated and potential sources of water for reuse were investigated. The processing included killing and bleeding, scalding and defeathering, evisceration, and washing and chilling. A sampling program determined that compressor cooling water was virtually clean and could be reused in the scalding and defeathering operations. Trace metal and bacterial levels in various process waters were determined. Bacterial contamination of scalding water was higher than that of washing or chilling waters. There was a direct relationship between bacterial counts in the water and on the carcasses. Continual renovation of the process water is needed to reduce grease and bacterial levels. (See also W80-00116) (Small-FRC) W80-00143

#### THE TREATMENT AND DISPOSAL OF WASTEWATER FROM DAIRY PROCESSING PLANTS,

Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.  
J. A. Moore, and B. M. Buxton.  
In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 427-442, 1977. 7 fig, 5 tab, 2 ref.

Descriptors: \*Standards, \*Dairy industry, \*Stabilization, \*Industrial wastes, Biochemical oxygen demand, Suspended solids, Aeration, Trickling filters, Oxidation lagoons.

The effect of water pollution standards on the cost of dairy products to the consumer was evaluated. The effluent of some typical processing plants and several common treatment systems were monitored including: a small transfer station with a package aeration plant, a transfer station with a trickling filter system, a small butter plant with two-stage lagoon treatment, and a large cheese and butter plant with two-stage aerated lagoon and chemical treatment. The butter plant using a two-cell stabilization pond exhibited highest treatment of COD and total solids. The package aeration plant showed the poorest performance. A stabilization pond and ridge furrow system performed well and required low management skills. (See also W80-00116) (Small-FRC) W80-00144

#### ALGAL ASSAYS FOR AREAS RECEIVING OR PROGRAMMED TO RECEIVE SEWAGE EFFLUENT,

Connecticut Univ., Storrs. Inst. of Water Resources.  
For primary bibliographic entry see Field 5A. W80-00193

#### DEVELOPMENT OF MICROWAVE PLASMA DETOXIFICATION PROCESS FOR HAZARDOUS WASTES. PHASE 1,

Lockheed Palo Alto Research Labs., CA.  
L. J. Bailin, and B. L. Hertzler.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-268 526, Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-77-030, 1977. 64 p, 23 fig, 5 tab, 13 ref, 3 append.

Descriptors: \*Microwaves, \*Degradation, \*Organic compounds, \*Pesticides, \*Laboratory tests, Pilot plants, Toxicity, Design criteria.

Microwave decomposition of organic materials was applied to the detoxification/destruction of hazardous organic pesticides and wastes using the Lockheed laboratory-size system. The detoxification process was then expanded to a larger-scale, continuous system using commercially available hardware. In the laboratory phase of the investigation, Malathion liquid, liquid PCB's, phenylmercuric acetate solution, and methyl bromide gas were tested, and the mechanics of the detoxification process were postulated. The expanded scale system was used to detoxify Malathion liquid, liquid PCB's, phenylmercuric acetate solution, and Kepone in the form of a solid powder, an aqueous slurry, and a solvent solution. Throughput of the system was maximized at 450 to 3200 g/hour, a multiplication factor of approximately 500 times that of the laboratory-scale unit. Specific engineering tasks are outlined for the construction of a pilot-scale unit for further testing of the system at 20 lb/hour. (Small-FRC) W80-00244

#### INFORMATION ABOUT HAZARDOUS WASTE MANAGEMENT FACILITIES,

Environmental Protection Agency, Washington, DC. Office of Solid Waste.  
D. Farb, and S. D. Ward.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-274 881, Price codes: A07 in paper copy, A01 in microfiche. Report EPA/530/SW-145, 1975. 130 p, 1 tab.

Descriptors: \*Waste disposal, \*Landfills, \*Water pollution sources, Data collections, Publications, Costs, Treatment facilities.

Information on 64 hazardous waste facilities is presented in the form of a standard resume. Telephone interviews and site visits were used to collect the information. This document provides guidance to hazardous waste generators who need assistance in proper landfill procedures. Facilities are listed by EPA region. A matrix of facilities vs. type of waste accepted is presented. Inclusion of a facility in the registry is based on the fact that EPA was aware of its existence; EPA does not endorse any of the facilities listed. The resumes include information on background, waste streams

accepted and excluded, waste handling methods employed, economics, and source of the information presented. (Small-FRC) W80-00245

#### BACHMAN TREATMENT FACILITY FOR EXCESSIVE STORM FLOW IN SANITARY SEWERS,

Texas A. and M. Univ., College Station. Dept. of Civil Engineering.  
H. W. Wolf.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-269 128, Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-77-128, 1977. 136 p, 32 fig, 39 tab, 3 ref, 1 append.

Descriptors: \*Municipal wastes, \*Storm water, \*Urban runoff, \*Treatment facilities, Sludge, Performance, Flocculation, Chlorination, Viruses, Waste water treatment.

The Bachman Treatment Facility which provides physical-chemical treatment to municipal waste water flows during periods of heavy precipitation, is described. Treatment includes the addition of waste sludge from a water purification plant, flocculation, sedimentation, tube settling, and chlorination. The effects of the addition of the waste sludges was investigated as laboratory studies indicated that better suspended solids removals and BOD-5 removals would result. Due to dry weather, artificially high flows were created using water from a nearby creek and potable water from a fire hydrant. Using artificial flows, no benefit was observed when waste sludges were added. On the few occasions that natural high flows occurred, some benefit was observed. Bacterial viruses were refractory to the combined chlorine residuals and contact time, and were good indicators of pollution from the facility. A desirable component of the facility is a grit removal process. There was no odor problem. (Small-FRC) W80-00246

#### METHODS FOR SEPARATION OF SEDIMENT FROM STORM WATER AT CONSTRUCTION SITES,

Science and Education Administration, Minneapolis, MN. St. Anthony Falls Hydraulic Lab.  
J. F. Ripken, J. M. Killen, and J. S. Gulliver.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-262 782, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/2-77-033, 1977. 91 p, 46 fig, 1 tab, 16 ref.

Descriptors: \*Construction, \*Runoff, \*Soil erosion, \*Water pollution sources, \*Separation techniques, Sieves, Settling basins, Filtration, Water treatment, Reviews.

The nature and amount of solids that may be transported by runoff at construction sites are discussed, and control methods are reviewed and evaluated. Simple sieves are usually not effective under most treatment conditions. Microstrainers should be considered if the site effluent contains solids above 25 to 30 microns in size. If a settling basin is used, a high rate gravity tube will not materially improve the effluent quality of a properly designed basin, but it can reduce the size of the required basins. A hydrocyclone is useful for removing fines, and centrifuges can produce effluent of a good quality but their costs are high. Stationary filters are effective for fines but are not useful at high flow rates. Rotary vacuum filters provide excellent effluent but must be attended and are expensive. At present, electrophoresis is not practical, and the upflow rapid sand filter is suggested for future study. This study is based on a review of published and unpublished technical literature. (Small-FRC) W80-00247

#### WATER REUSE IN A WET PROCESS HARD-BOARD MANUFACTURING PLANT,

Superior Fiber Products, Inc., WI.  
R. L. Coda.  
Available from the National Technical Information

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

Service, Springfield, VA 22161 as PB-286 607. Price codes: A04 in paper copy, A01 in microfiche. Report EPA-600/2-78-150, 1978. 42 p, 21 fig, 4 tab, 3 ref.

Descriptors: \*Industrial wastes, \*Industrial water, \*Recirculated water, Biochemical oxygen demand, Water pollution sources, Waste water treatment, Industrial production.

A project is described which was designed to eliminate any discharge of process water during the manufacture of smooth on one side, wet process hardboard. Before water reuse, the plant discharged about 757,000 liters/day of white water with a BOD-5 loading of 2710 Kg/day. After a system of complete white water reuse was installed, discharges of about 18,925 liters/day with a loading of about 340 Kg/day BOD-5 resulted. White water total solids concentration increased from 1% to about 7% with water reuse. Hardboard strength was equal to or better than the strength produced before the closed system was introduced. The closed system used less chemicals, both during the manufacturing process and during waste water treatment. Some disadvantages of the closed system are darker board color and overall reduced cleanliness of the mill. The highly concentrated white water leaves increased residue when spilled. The residual waste flow consisting of wash water and small amounts of white water leakage, will be reduced or eliminated in the future. (Small-FRC) W80-00250

**REUSE OF FERMENTATION BRINES IN THE CUCUMBER PICKLING INDUSTRY.** Michigan State Univ., East Lansing. Dept. of Food Science and Human Nutrition. R. F. McFeeters, W. Coon, M. P. Palnitkar, M. Velting, and N. Fehring. Available from the National Technical Information Service, Springfield, VA 22161 as PB-288 585. Price codes: A07 in paper copy, A01 in microfiche. Report EPA-600/2-78-207, 1978. 116 p, 5 fig, 79 tab, 35 ref, 1 append.

Descriptors: \*Recycling, \*Brines, \*Food processing industry, \*Feasibility studies, On-site investigations, Industrial water, Temperature, Hydrogen ion concentration, Costs.

The technology and economic feasibility of recycling cucumber brines was evaluated on a commercial scale. Studies were conducted to determine the performance of two brine treatments: heat treatment and chemical treatment. Heat treatment of 175 F for 30 seconds was sufficient to inactivate pectinases from molds found to be common on cucumber fruits and flowers. A brine temperature of 72 F or higher was necessary for effective chemical treatment. Also, pH had to be maintained at 11.0 or higher for at least 36 hours to ensure 99% pectinase inactivation. Using the recycling procedures, a small net savings was realized with the heat treatment method while a small net cost resulted with the chemical treatment. Brine can be reused at least three times on a commercial basis. There were no ill effects of recycling. (Small-FRC) W80-00251

**FIELD MANUAL FOR PERFORMANCE EVALUATION AND TROUBLESHOOTING AT MUNICIPAL WASTEWATER TREATMENT FACILITIES.** Culp/Wesner/Culp, El Dorado Hills, CA. G. L. Culp, and N. F. Heim. Available from the National Technical Information Service, Springfield, VA 22161 as PB-279 448. Price codes: A18 in paper copy, A01 in microfiche. Report EPA-430-9-78-001, 1978. 396 p, 105 fig, 42 fig, 6 ref.

Descriptors: \*Treatment facilities, \*Design criteria, \*Evaluations, \*Municipal wastes, Waste water treatment, Performance, On-site tests, Environmental engineering.

This manual is a technical field guide or reference document to be used in projects to improve the

performance of municipal waste water treatment plants. It is a troubleshooting guide for identifying problems, analyzing problems, and solving problems. A step-by-step procedure is outlined for organizing information before a plant is visited for an on-site evaluation. Overall system considerations are presented. Unit processes are described and the effect of each process on other system processes is considered. Information is presented in safety, staffing, monitoring, emergency procedures, and maintenance considerations. Unit processes are also evaluated. Forty processes are described, and typical design criteria and performance evaluation are presented. Also, design shortcomings are discussed for each of the forty processes, and ways of overcoming these shortcomings are presented. (Small-FRC) W80-00253

**AIRCRAFT INDUSTRY WASTEWATER RECYCLING.** Boeing Commercial Airplane Co., Seattle, WA. A. K. Robinson, and D. F. Sekits. Available from the National Technical Information Service, Springfield, VA 22161 as PB-286 210. Price codes: A06 in paper copy, A01 in microfiche. Report EPA-600/2-78-130, 1978. 92 p, 14 fig, 11 tab, 8 ref, 8 append.

Descriptors: \*Recycling, \*Feasibility studies, \*Costs, \*Industrial water, Chemical wastes, Dyes, Industrial wastes, Waste water treatment.

The feasibility of recycling certain categories of water used during the manufacture of aircraft was investigated. Waters studied included chemical process rinse water, dye-penetrant crack-detection rinse water, machine shop coolant, and cyanide-containing rinse water. Water used only for cooling and sanitary water were not included. Three hundred liter treatment plants were used to continuously purify and then recontaminant water in a closed demonstration loop. The cost of a full-scale treatment plant was estimated. For an airplane factory generating 1.5 MI/day the capital cost including installation was estimated at \$3.4 million; and recycling costs of \$0.94/kg for chemical process rinse water, \$1.65/kg for dye-penetrant rinse water, \$4.36/kg for cyanide rinse water, and \$12.18/kg for machine shop coolant. (Small-FRC) W80-00255

**IMMOBILIZATION OF HAZARDOUS RESIDUALS BY ENCAPSULATION.** Washington State Univ., Pullman. Dept. of Materials Science and Engineering. R. V. Subramanian, and R. Mahalingam. Available from the National Technical Information Service, Springfield, VA 22161 as PB-262 648. Price codes: A03 in paper copy, A01 in microfiche. Report NSF/RA-760361, 1976. 39 p, 8 fig, 5 tab, 4 ref, 1 append.

Descriptors: \*Industrial wastes, \*Waste disposal, \*Polymers, \*Laboratory tests, Water pollution sources, Leachate, Safety, Hazards.

Described is research progress made in an attempt to encapsulate hazardous wastes in a water-extensible polyester matrix to yield solidified products with rigid, light-weight shock proof structures. The wastes could then be safely stored, transported, and disposed of in landfills or burial grounds. Laboratory investigations were carried out, and some semi-continuous pilot studies were made. Immobilization of low-level radioactive wastes and some chemical wastes was achieved in three steps: preparation of a waste solution or slurry in an aqueous medium, continuous emulsification and encapsulation by the polymer resin, and solidification of the emulsion in small-volume cans. Uniform emulsions were formed and the quality of the encapsulation was excellent. (Small-FRC) W80-00256

**THE ECONOMIC IMPLICATIONS OF WATER RE-USE.** Environmental Control Consultancy Services Ltd., London (England). D. Anderson, and R. H. Marks.

Chemica, Vol. 3, No. 9, p 149-150, 1977. 2 tab.

Descriptors: \*Reclaimed water, \*Water reuse, \*Costs, \*Biological treatment, \*Industrial water, Filtration, Chlorination, Activated carbon, Economics.

Some of the economic aspects of water reuse are explored and related to relevant technology. Economic design criteria are reviewed including total fixed investment, operating cost, and profit rates. An equation is presented for cost estimates. Water reuse technology is discussed briefly. An example is presented of water reuse and reclamation at Schwepes Ltd., Aylesbury, UK. The reuse process employs biological treatment, sand filtration, chlorination, activated carbon treatment, and pasteurization. When the high costs of water intake and sewage disposal are considered, the water reuse system realizes a net annual savings of about 40,000 pounds sterling even when 12% is allowed for amortization and interest payments on capital. (Small-FRC) W80-00257

**CURRENT TECHNOLOGY AND RESEARCH ON RE-USE OF EFFLUENTS.** National Inst. for Water Research, Pretoria (South Africa). G. G. Cillie. Saccap Action News, Vol. 3, No. 2, p 10-13, 1977. 2 fig.

Descriptors: \*Recycling, \*Sewage treatment, \*Waste water treatment, \*Biological treatment, Irrigation, \*Chlorination, Lime, Separation techniques, Pathogenic bacteria, Nitrogen, Phosphorus, Organic compounds, Heavy metals.

Current effluent reuse practices and processes available for renovating waste waters are reviewed. In South Africa, of the 1230 ml/day purified sewage effluents produced, 31.9% is reused. Of this, 16.1% is used for irrigation, 8.7% for power plant cooling systems, and 7.1% for industrial purposes. The various waste water treatment processes used to renovate waters remove nitrogen, phosphorus, organic carbon, dissolved minerals, heavy metals, pathogens, and toxicants. Biological treatment and chlorination are used for the removal of nitrogenous compounds and bacterial treatment and chemical precipitation are used to control phosphorus. Lime treatment removes heavy metals, biological oxidation and activated carbon remove organic carbon compounds, and ion exchange, reverse osmosis, and electrodialysis are used for demineralization. Pathogens are removed by irradiation and chemical treatment such as chlorination. The Windhoek plant which reclaims potable water from conventional biofilter sewage effluent is described. (Small-FRC) W80-00258

**MODERNISED SYSTEM FOR CAPE TOWN.** Construction in South Africa, Vol. 22, No. 12, p 42-43, 45, 47, 1978. 4 fig.

Descriptors: \*Municipal wastes, \*Treatment facilities, \*Recycling, \*Outlets, Activated sludge, Water purification, Aeration, Sewage treatment.

The modernization and extension of Cape Town's municipal sewage treatment facilities are described. At the new Camps Bay sea outfall, sewage is macerated, screened, chlorinated, and 5 megaliters/day are discharged 1500 m from shore at a depth of 25 m. Plans for the Athlone treatment works are described which include diversion of some municipal and industrial wastes so that effluent meets General Standards with the possible exception of salinity. A parallel activated sludge plant may be necessary at Athlone, and construction of new inlet works is planned. The Cape Flats reclamation works is described which will replace the existing oxidation ponds with a conventional aerated activated sludge system with added anaerobic, anoxic, and aeration zones to complete denitrification. Public relation campaigns are planned to persuade the public that it is possible to reclaim water. The Mitchells Plain treatment works is also described which will be a part of a planned city-

Waste Treatment Processes—Group 5D

1977. 2 tab.  
water reuse,  
trial water,  
arbon, Eco-

or reuse are  
ology. Eco-  
cluding total  
profit rates.  
ates. Water  
An example  
amation at  
reuse proced-  
filtration,  
nt, and pas-  
intake and  
water reuse  
about 40,000  
allowed for  
on capital.

RESEARCH  
oria (South  
10-13, 1977.

treatment,  
treatment, ir-  
ation tech-  
Phosphorus,

Processes  
ers are re-  
l/day puri-  
is reused.  
8.7% for  
for indus-  
for treat-  
move nitro-  
added miner-  
cants. Bio-  
used for the  
and bacterial  
are used to  
at removes  
and activated  
ounds, and  
ectrodialysis  
ens are re-  
treatment such  
which renal  
biofilter  
(C)

PE TOWN.  
t, No. 12, p

tment facili-  
udge, Water  
nt.

ape Town's  
e described.  
sewage is  
d 5 mega-  
shore at a  
e treatment  
diversion of  
o that efflu-  
the possible  
ated sludge  
and construc-  
Cape Flats  
will replace  
conventional  
added anaer-  
complete deni-  
to reclaim  
works is also  
lanned city-

within-a-city and is expected to handle 50 mega-liters per day. (Small-FRC)  
W80-00259

**THE PUMPING OF WATER FROM MINES IN THE CENTRAL WITWATERSRAND,**  
East Rand Proprietary Mines, Ltd., Boksburg (South Africa).  
J. A. Tyser.  
Journal of the South African Institute of Mining and Metallurgy, Vol. 77, No. 10, p 207-213, 1977. 6 fig.

Descriptors: \*Acid mine water, \*Lime, \*Water treatment, \*Treatment facilities, Aeration, Coagulation, Mine water, Industrial wastes.

A system for the removal and treatment of mine water from underground mines in the central Witwatersrand, South Africa, is described. The water is pumped by a pump station on 24 level to a surface lime plant and a treatment plant. The mine water is acidic (pH 3.5) and contains a high proportion of solids. After the addition of lime, the water is treated to produce water with a minimum pH of 5.5 and less than 25 ppm suspended solids and discharged into a public stream. The plant is comprised of two concrete thickeners, two concrete lime-mixing tanks, and four concrete aeration tanks. Sludge is pumped to a reduction plant where it is used for repulping or directly to the slimes dam. (Small-FRC)  
W80-00260

**SEWAGE TREATMENT - THE STATE OF THE ART.**

Johannesburg City Council (South Africa).  
C. Davis.  
Construction in South Africa, Vol. 22, No. 12, p 34, 35, 37, 39, 41, 1978. 3 fig.

Descriptors: \*Sewage treatment, \*Activated sludge, \*Nitrates, \*Phosphates, \*Biological treatment, \*Tertiary treatment, Ion exchange, Chemical precipitation, Water purification, Sludge disposal.

A review of current sewage treatment methods is presented. Variations of the activated sludge process are described including pure oxygen aeration. The removal of nutrients such as nitrates and phosphates can be performed by chemical means such as precipitation and ion exchange, and by more recently developed biological means. Nitrate removal utilizes bacteria which, when deprived of free oxygen, change to an anoxic metabolism in which they derive oxygen from nitrate. Tertiary treatment methods which can produce drinking water from sewage effluent are discussed. A common process stream is: coagulation, sedimentation, ammonia stripping, sand filtration, activated carbon adsorption, and chlorination. Sludge disposal methods are discussed and alternatives to water-borne sewage systems are mentioned. (Small-FRC)  
W80-00261

**PRESSURE FILTERS FOR SPECIALISED WASTEWATER TREATMENT.**

Energy, Vol. 3, p 25, 27, May 1977. 2 fig, 1 tab.

Descriptors: \*Filtration, \*Water pressure, \*Radioactive wastes, \*Waste disposal, Activated carbon, Ion exchange, Diatomaceous earth, Drying, Waste storage.

Pressure filters using a diatomaceous earth, activated carbon or ion exchange resin powder precoat are used for the treatment of nuclear power plant waste water. The pressure filters remove solid radioactive residues and the slurries are piped to a central collection plant where final filtration and drying take place. The dry radioactive residues are enclosed and solidified in drums of bitumen and removed to a final storage site. (Small-FRC)  
W80-00264

**STANGER PULP AND PAPER MILL - CLEARING THE WATER.**

Prospect, Vol. 16, No. 4, p 16-18, 1977.

Descriptors: \*Pulp and paper industry, \*Industrial wastes, \*Incineration, \*Recycling, Suspended solids, Aeration, Dewatering, Landfills, Chemical wastes.

The efforts of Stanger Pulp and Paper of South Africa to control pollution are summarized. The company attempts to recover chemicals used in the production process by burning treatable toxic effluent and by recycling the treatable effluent. After the bagasse is converted to pulp, excess water is evaporated from the effluent, and the solids are converted to soda ash in Copeland reactors. During paper making, effluent water is discharged, collected, and pumped to the treatment plant where large solid particles are removed, and clarification and aeration take place. Residual sludge is dewatered and used as landfill. (Small-FRC)  
W80-00265

**BOTANICAL CONTROL: PURIFYING INDUSTRIAL WASTEWATER,**

J. Joseph.  
Municipal Engineer, Vol. 9, No. 4, p 49, 51, 53, 1978. 1 fig.

Descriptors: \*Water hyacinth, \*Industrial wastes, \*Aquatic plants, \*Waste water treatment, \*Absorption, Phenols, Pesticides, Chemical wastes, Metals, Strontium, Performance.

The use of water hyacinths to purify industrial waste water is discussed. Field studies performed by the National Aeronautics and Space Administration demonstrated that hyacinths can be used to remove a broad spectrum of industrial wastes. Within as short a time span as 24 hours, water hyacinths can absorb most of the chemical and organic contaminants in industrial effluent, including phenols, pesticides, rare polluting metals, and strontium. For example, approximately half a hectare of water hyacinths can absorb and remove 105.6 grams of lead over a twenty-four hour period. Mervinphos can be removed, adsorbed, metabolized and concentrated by a number of vascular aquatic plants. Join-grass and water lily removed from 87 to 93 ppm of Mervinphos from test systems in less than two weeks without apparent damage to the plants. Thus far, investigations have revealed no significant industrial pollutants which can not be removed by vascular aquatic plants. Normal concentrations of the wastes do not even slow the growth of the plants. (Small-FRC)  
W80-00266

**ROODEPOORT NOW HANDLES OWN WASTEWATER,**

J. H. Snell.  
Imesia, Vol. 3, No. 3, p 13-15, 1978. 5 fig, 1 tab.

Descriptors: \*Domestic wastes, \*Treatment facilities, \*Municipal wastes, \*Activated sludge, Chlorination, Waste disposal, Nitrogen, Phosphorus, Anaerobic treatment, Aerobic treatment, Aeration.

The Driefontein Water Pollution Control Works of the City of Roodepoort is described. Roodepoort was initially served by several small activated sludge units and by the facilities in nearby Johannesburg. The new Roodepoort facility has a capacity of 14 ML/day for preliminary treatment and 7 ML/day as an average dry weather flow. The Phoredox system is utilized: anaerobic zone, anoxic zone, aerobic zone, second anoxic zone, and re-aeration. The system is designed to remove more than 75% nitrogen and 50% phosphorus. Effluent from the sedimentation tanks will be chlorinated and discharged into the Crocodile River; the phosphorus-rich filtrate will be disposed of on land. The plant should meet the community's needs until 1983. (Small-FRC)  
W80-00267

**ANALYSIS OF WASTEWATER LAND TREATMENT SYSTEMS IN THE PHOENIX URBAN AREA,**

Boyle Engineering Corp., Phoenix, AZ.  
R. L. Ewing.  
In: Hydrology and Water Resources in Arizona

and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, April 14-15, 1978, Flagstaff, Az., Vol. 8, p 26-32, 3 fig, 11 ref.

Descriptors: \*Waste water treatment, \*Environmental sanitation, \*On-site investigations, \*Sewage treatment, \*Alternate planning, Recycling, Water pollution treatment, Effluents, Computer programs, Economic feasibility, Phoenix, Arizona.

Wastewater land treatment systems are ideally suited for the treatment of primary and secondary treatment plant effluents in the Phoenix area and other arid desert regions where water is a scarce and valuable resource. The site specific nature of such systems necessitates the preliminary investigation and comparison of a large number of alternative techniques to facilitate a realistic economic and engineering evaluation. Reported is a summary of a computer analysis technique designed to analyze each site based upon factual site specific criteria, as to its suitability to irrigation, infiltration-percolation, and overland flow methods of land application of wastewater. Criteria considered in this initial evaluation process were the general location as it related to the existing wastewater system and its compatibility with proposed land usage in the general proximity, the general environmental setting including climate, topography, soil characteristics, groundwater conditions as well as the identification of historically and archaeologically sensitive areas, appropriate costs, power usage and land requirements. To date the Phoenix area '208' urban study has evaluated approximately 35 sites with a total of over 50 land treatment alternatives being considered. 27 of 35 sites have been eliminated. (Tickes-Arizona)  
W80-00272

**LAND TREATMENT OF PRIMARY SEWAGE EFFLUENT: WATER AND ENERGY CONSERVATION,**

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.

R. C. Rice, and R. G. Gilbert.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, April 14-15, 1978, Flagstaff, Az., Vol. 8, p 33-36, 2 tab, 7 ref.

Descriptors: \*Waste treatment, \*Waste water treatment, \*Water pollution treatment, \*Water conservation, Activated sludge, Sewage effluents, Cost-benefit analysis, Feasibility studies, Energy budget, Water quality, Alternative planning, Effluents, Conservation.

A cost and energy budget analysis of land treatment of primary sewage effluent is presented to illustrate how these techniques are cost-effective and energy saving alternatives for wastewater treatment that eliminate the cost and energy requirements of the more conventional secondary activated sludge treatment and produce high quality renovated water. Preliminary laboratory and field studies have shown that primary effluent can be successfully treated by land application and yield water whose quality equals that of renovated secondary effluent at about half the energy requirement. (Tickes-Arizona)  
W80-00273

**EFFECT OF ALGAL GROWTH AND DISSOLVED OXYGEN IN REDOX POTENTIALS IN SOIL FLOODED WITH SECONDARY SEWAGE EFFLUENT,**

Science and Education Administration, Phoenix, AZ. Water Conservation Lab.

R. G. Gilbert, and R. C. Rice.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, Flagstaff, Az., 1978, p 132-136, 2 fig, 15 ref.

Descriptors: \*Algae, \*Algal control, \*Waste water treatment, \*Effluents, \*Microbial degradation,

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

\*Nitrogen cycle, Dissolved oxygen, Nitrification, Chemical reactions, Soil-water-plant relationships, Environmental effects, Sewage treatment, Growth stages, Denitrification.

The land application of wastewater has been shown to be an effective method for the renovation of secondary sewage effluent (SSE) although the nitrifying activity associated with this treatment has been related to the growth and activity of algae. The objectives of this study were therefore to investigate the effects of algal growth on dissolved oxygen and Eh in soil basins flooded with SSE and to locate and characterize those regions in the soil-water system, during flooding periods, where microbial processes and environmental conditions were favorable for denitrification and the N-removal from the SSE. Flooding and drying cycles of 14 days each were carried out at the Flushing Meadows Project Experimental Site in the Salt River bed near Phoenix, Arizona that maximized hydraulic loading and produced N-removal rates of about 30% while the water table below the soil basin rose from 3 to 2 m deep during flooding. Results indicated that nitrification, which must occur before denitrification can proceed, was associated with the growth and development of algae on the surface of the soil basin during each flooding period. The daily activity of algae produced diurnal fluxes of DO and Eh that induced conditions favorable for nitrification. Subsequently, the nitrate-N and/or nitrite-N formed would be denitrified, while infiltrating through the reduced zones of the organic sediments and surface 2 cm of soil. (Tickes-Arizona) W80-00286

#### BOD/TOC CORRELATIONS AND THEIR APPLICATION TO WATER QUALITY EVALUATION

Waterloo Univ. Research Inst. (Ontario). T. W. Constable, and E. R. McBean. Water, Air, and Soil Pollution, Vol. 11, No. 3, p 363-375, April 1979. 8 fig, 2 tab, 13 ref.

Descriptors: \*Water quality, \*Biochemical oxygen demand, \*Carbon, \*Model studies, Mathematical models, Effluents, Sewage effluents, Organic matter, Microbial degradation, Microorganisms, Waste treatment, Biological treatment, Sewage treatment, Model comparisons.

The error residual for TOC analysis was examined with the result that two BOD5/TOC models were suggested, both of which use a multiplicative error structure. A comparison of these models with the historically-assumed linear BOD5/TOC model was created for data collected from the City of Waterloo Water Pollution Control Plant. The predictive capabilities of the derived BOD5/TOC models were examined for interpolation and extrapolation potentials for augmenting water quality data information bases. Use of the models to reduce the statistical uncertainty associated with BOD measurements was considered. (Sims-ISWS) W80-00353

#### THE UPTAKE OF 226RA BY PLANKTONIC ALGAE UNDER CONDITIONS OF CONTINUOUS CULTIVATION

Institut Hygieny a Epidemiologie, Prague (Czechoslovakia). Dept. of General Public Hygiene. For primary bibliographic entry see Field 5A. W80-00394

### 5E. Ultimate Disposal Of Wastes

#### DEVELOPMENT OF A SYNTHETIC MUNICIPAL LANDFILL LEACHATE

Wisconsin Univ.-Madison. R. Stanforth, R. Ham, M. Anderson, and R. Stegmann. Journal of the Water Pollution Control Federation, Vol. 51, No. 7, p 1965-1975, July 1979. 4 fig, 8 tab, 14 ref.

Descriptors: \*Landfills, \*Leaching, \*Model studies, Mathematical models, Chemicals, Wastes,

Waste disposal, Degradation, Leachate, Acids, Industrial wastes, Municipal wastes, Hydrogen ion concentration, Oxidation-reduction potential, Organic compounds, Ions, Aerobic conditions, Synthetic leachate.

The development of a synthetic municipal landfill leachate for use in laboratory leaching tests on industrial wastes was described. The parameters most likely to be of importance in leaching materials from industrial wastes were identified, and the concentrations of those parameters found in aggressive landfill leachate were determined by a literature search. Compounds were chosen to model the parameters and were combined in a synthetic leachate at the concentrations necessary for aggressive landfill leachate. (Sims-ISWS) W80-00071

#### 2ND USA/USSR SYMPOSIUM ON PHYSICAL/CHEMICAL TREATMENT FROM MUNICIPAL AND INDUSTRIAL SOLIDS, HELD AT THE TAFT CENTER, CINCINNATI, OHIO, NOVEMBER 12-14, 1975

For primary bibliographic entry see Field 5D. W80-00097

#### PROCESSING AND NEUTRALIZATION OF INDUSTRIAL WASTES FROM IRON AND STEEL EFFLUENTS TREATMENT

For primary bibliographic entry see Field 5D. W80-00114

#### FUNDAMENTAL PRINCIPLES OF SELECTING THE METHOD FOR PROCESSING SEWAGE SEDIMENTS IN ACCORDANCE WITH THEIR PROPERTIES

For primary bibliographic entry see Field 5D. W80-00115

#### PRELIMINARY EVALUATION OF ANAEROBIC SLUDGE DIGESTION FOR THE TUNA PROCESSING INDUSTRY

Washington Univ., Seattle. Sea Grant Program. A. Kissam, H. Barnett, F. Stone, and P. Hunter. In: Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, p 155-168, 1977. 1 fig, 5 tab, 18 ref.

Descriptors: \*Anaerobic digestion, \*Food processing industry, \*Sludge treatment, \*Suspended solids, Economics, Performance, Sludge disposal, Screens, Flotation.

An anaerobic digestion demonstration project for the treatment of tuna processing sludge is described and discussed. The test sludge was obtained from a plant which treated waste water by screening followed by dissolved air flotation using 200 ppm alum, 100 ppm lime, and 5 ppm anionic acids. Removal and operating parameters are presented for three digester detention times: 8, 12, and 15 days. Using the system, a total dry solids loading of 6100 pounds per day would be reduced by 55% with anaerobic digestion. A total annual reduction in expenses of \$78,000 is projected. Use or marketing of the methane gas produced by the digester could result in further savings. (See also W80-00116) (Small-FRC) W80-00127

#### PHYSICAL AND ENGINEERING PROPERTIES OF HAZARDOUS INDUSTRIAL WASTES AND SLUDGES

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Effects Lab. For primary bibliographic entry see Field 8G. W80-00243

#### IMMOBILIZATION OF HAZARDOUS RESIDUALS BY ENCAPSULATION

Washington State Univ., Pullman. Dept. of Materials Science and Engineering. For primary bibliographic entry see Field 5D. W80-00256

#### OPERATION AND CONTROL OF WATER PURIFICATION PLANTS, PART II, National Inst. for Water Research, Pretoria (South Africa).

J. R. H. Hoffman. Imesia, Vol. 2, No. 4, p 19-23, 1977. 2 fig.

Descriptors: \*Water purification, \*Filtration, \*Chlorination, \*Settling basins, Operations, Performance, Flow rates, Disinfection.

This second part of a series on operation and control of water purification plants discusses sedimentation, filtration, and chlorination. Horizontal flow and upward flow settling tanks are described and their proper operation is discussed. Filtration to remove particles not settled out is discussed including considerations of filtering media, the hydraulics of filtration, backwashing, filter performance, and filter rate control. Chlorine disinfection is explained through descriptions of the chemistry of chlorine in water, break-point chlorination, the design of chlorine contact tanks, and levels of chlorine residuals which should prevail in the distribution system. (Small-FRC) W80-00262

#### THE USE OF FERRIC CHLORIDE AS A FLOCCULATING AGENT IN THE TREATMENT OF DRINKING WATER

N. J. H. Grobbelaar, and H. R. Ernst. Energy, Vol. 3, p 23, 27, May 1977. 1 tab.

Descriptors: \*Flocculation, \*Chlorides, \*Water purification, \*Potable water, Operations, Performance, Costs.

Successful flocculation using ferric chloride is described including its use when water works are overloaded or poorly designed. A new process which produces ferric chloride as a 43% (w/w) solution at a competitive price has made this process feasible for South African plants. The physical properties of ferric chloride solution are described, and the various operations involved in the treatment process are explained. Important flocculant parameters include the time of formation which influences retention time, and the time it takes for complete settling to take place. A trial run is necessary to determine the usefulness of ferric chloride for a particular operation. (Small-FRC) W80-00263

### 5F. Water Treatment and Quality Alteration

#### TRICKLE IRRIGATION: PREVENTION OF CLOGGING

Science and Education Administration, Phoenix, AZ. Water Conservation Lab. R. G. Gilbert, F. S. Nakayama, and D. A. Bucks. Transactions of the American Society of Agricultural Engineers, Vol. 22, No. 2, p 514-519, May-June 1979. 4 fig, 4 tab, 17 ref.

Descriptors: \*Irrigation, \*Colorado River, \*Clogging, \*Irrigation operation and maintenance, Irrigation practices, Water treatment, Chemicals, Water quality, Suspended solids, Bacteria, Filters, Filtration, On-site investigations, Agriculture, \*Trickle irrigation, Emitter clogging.

Trickle irrigation experiments using Colorado River irrigation water on citrus trees in southwestern Arizona were conducted to evaluate clogging of emitters and to investigate methods for controlling clogging. Clogging is related to the water quality in terms of the suspended sediment load, chemical composition, and biological activity. Various combinations of 6 water treatments, including screen and sand filtration coupled with additions of hypochlorite and acid, were used with 8 different trickle emitters to evaluate long-term prevention of clogging. Five of the 8 emitter systems under study (No. 1, 5, 6, 7, and 8) required sand and screen filtration (200-mesh) plus chemical treatments to prevent physical clogging of the emitters by suspended materials and to maintain flow rates greater than 70% of the design flow. Three emitter systems (No. 2, 3, and 4) continued to operate at

Techniques Of Planning—Group 6A

greater than 80% of the design flow rate with only screen filtration (50-mesh). The results after 2 yr have indicated that clogging of emitters could be prevented by proper treatment of Colorado River water, which includes in the following order of preference: (1) filtration system for prevention of the rapid physical clogging of emitters caused by suspended materials, (2) chemical treatments for long-term prevention of chemical clogging of emitters caused by precipitation of carbonates, and (3) chemical treatments for long-term prevention of biological clogging of emitters caused by microbial growth and slime development. (Sims-ISWS) W80-00074

**ALGAL ASSAYS FOR AREAS RECEIVING OR PROGRAMMED TO RECEIVE SEWAGE EFFLUENT.**  
Connecticut Univ., Storrs. Inst. of Water Resources.  
For primary bibliographic entry see Field 5A. W80-00193

**RICHARDS BAY MZINGAZI WATER PURIFICATION WORKS.**  
D. Langenegger, and P. B. B. Vosloc.  
Municipal Engineer, Vol. 9, No. 1, p 71-73, 1978. 4 fig.

Descriptors: \*Water purification, \*Chlorination, \*Filtration, \*Flocculation, \*Potable water, Treatment facilities, Lime, Water quality, Lakes, Reservoirs.

Preliminary studies and the design of the Mzingazi Water Purification Works are reviewed. A water treatment plant was designed to treat water from the Mzingazi Lake to provide potable water for the developing community of Richards Bay. Initially, a temporary treatment plant was utilized while the water quality of the lake was evaluated. In the temporary plant problems occurred with proper flocculation, and in the final design, stepwise addition of aluminum sulfate was planned. Because of development along the edges of the lake and the accompanying deterioration of water quality, prechlorination was investigated as a possibility for the future. In the final plan, water will be dosed with aluminum sulfate, mixed, and then filtered. Chlorine is added and lime is used to raise the pH. The water will be stored in two reservoirs. (Small-FRC) W80-00268

**NITROGEN REMOVAL FROM SECONDARY EFFLUENT APPLIED TO A SOIL-TURF FILTER.**

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering; and Oklahoma State Univ., Stillwater. Soil Testing Lab.  
E. L. Anderson, I. L. Pepper, and G. V. Johnson.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az., p 37-44, 4 fig, 2 tab, 17 ref.

Descriptors: \*Turf grasses, \*Filters, \*Trickling filters, \*Waste water treatment, \*Water pollution treatment, \*Effluents, \*Nitrogen, Water pollution sources, Lysimeters, Drip irrigation, Sands, Leachate, Water quality.

The potential of soil-turfgrass filters as a tertiary treatment for secondary effluent was investigated in this study conducted at the University of Arizona Turfgrass Research Center in Tucson, Arizona. Twenty 1m<sup>2</sup> by 60 cm deep lysimeters were arranged in a split plot design with 2 different soils, a sand and a sand mixture, 5 application rates of 10, 17, 22, 34 and 43 mm/day applied twice daily, with 15 mm drip irrigation lines with two replicates of each rate. Results indicated that sand had a higher percent recharge than the mix while the mix soil had a higher purification efficiency and percent utilization than sand. The maximum rate of effluent application in sand that yielded leachate averaging less than 10 ppm NO<sub>3</sub>-N was 22 mm/day while on the sand mixture 43 mm/day yielded leachate

meeting this criterion. This study demonstrates the potential of soil turfgrass as a tertiary treatment for secondary effluent particularly in arid regions where water is a limited resource. (Tickes-Arizona) W80-00274

**WASTEWATER REUSE-HOW VIABLE IS IT. ANOTHER LOOK.**

Stevens, Thompson and Runyan, Inc., Phoenix, AZ.  
W. L. Chase, and J. Fulton.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Az. p 110-114, 2 tab.

Descriptors: \*Waste water treatment, \*Water reuse, \*Water resources planning, \*Economic feasibility, Water pollution control, Community development, Comprehensive planning, Alternate planning, Water quality control, Sludge treatment, Cost analysis, Salt River Valley, Arizona, Hydrologic budget, Water shortage.

Water reuse in the Phoenix area is analyzed in terms of both the problems that must be solved and the advantages that a well planned reuse system would bring. In the absence of a generally accepted agreement on the seriousness of the long-term water shortage in the Salt River Valley, it is difficult for these communities to decide upon which reuses are viable, what level of treatment is required for those reuses, and how much they are willing to pay for additional sources of water. The wastewater treatment alternatives that are being discovered through the 208 water quality program such as the conventional vs. land treatments, alternative collection systems; and different methods of sludge collection, treatment, and disposal are enumerated and cost analyzed while pointing out the many problems that must first be solved. (Tickes-Arizona) W80-00283

**THERMAL ALTERATION OF GROUND-WATER CAUSED BY SEEPAGE FROM A COOLING LAKE.**

Northern Cheyenne Research Project, Lame Deer, MT.  
For primary bibliographic entry see Field 5B. W80-00358

5G. Water Quality Control

**SCALE-INHIBITING COMPOSITIONS FOR AQUEOUS SOLUTIONS.**

Etalissements Kuhlmann, Paris (France). Produits Chimiques.  
H. Roques, and A. Girou.  
U.S. Patent No. 4,148,728, 6 p, 1 fig, 2 ref; Official Gazette of the United States Patent Office, Vol. 981, No. 2, p 604, April 10, 1979.

Descriptors: \*Patents, \*Scaling, \*Water quality control, Industrial water, Desalination apparatus, Calcium carbonates, Water treatment, \*Fluorocarbons.

The invention is based upon a study of the type of activity exhibited by fluorocarbons, as well as the activity of conventional boiler compounds, in order to provide scale-inhibiting compounds with excellent performance. It has been found that the fluorocarbon derivatives can affix themselves to a substrate and provide antiscaling properties, with activity at the heterogeneous germination level, and that they will inhibit scale deposits on the surfaces of substrates studied. The invention also provides methods for treating aqueous solutions and surfaces to prevent scale formation on such surfaces. (Sinha-OEIS) W80-00005

**WATER QUALITY MANAGEMENT ACCOMPLISHMENTS COMPENDIUM I.**

Environmental Protection Agency, Washington, DC. Water Planning Div.  
For primary bibliographic entry see Field 6E. W80-00242

**PLANNING FOR ENVIRONMENTAL MANAGEMENT: NEW DIRECTIONS AND INITIATIVES.**

Research Group, Inc., Atlanta, GA.  
For primary bibliographic entry see Field 6E. W80-00386

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

**THEORY AND APPLICATION OF ENVIRONMENTAL ECONOMICS.**

Vrije Univ., Amsterdam (Netherlands). P. Nijkamp.  
Studies in Regional Science and Urban Economics, Volume 1. A. Andersson and W. Isard, Eds., North-Holland Publishing Company, Elsevier North-Holland, Inc., New York, N.Y., 1977. 332 p.

Descriptors: \*Environmental control, \*Economics, \*Analytical techniques, \*Ecology, \*Optimization, \*Environmental quality, Water quality, Air pollution, Cost-benefit analysis, Design, Mathematical models, Equations, Systems analysis, Decision making, Degradation(Decomposition), Political aspects, Ethics, Welfare, Interdisciplinary, Regional science, Urban economics, Social aspects, Conceptual frameworks, Data, Market mechanism, Uncertainty.

This monograph is the first in a series designed to give to a wide audience with transdisciplinary interests the most advanced contributions to analysis in the fields of regional science and urban economics. It attacks the problem of environmental management. The economics considered is a very broad-ranging one which introduces basic social, political, and cultural factors into the analysis, including ethics and key welfare considerations. An advanced textbook on the economic aspects of environmental problems, the monograph aims to (1) provide theoretical insight into economic aspects of environmental problems by presenting broad surveys of existing theories; (2) achieve mastery of a set of new theories and methods in environmental economics by developing new tools for dealing with intangibles; and (3) contribute to an operational analysis of environmental problems by presenting various empirical applications. The individual chapters consider: (1) economics and ecology—a synthesis; (2) ecologic valuation of natural environments; (3) environmental externalities; (4) programming models for environmental quality analysis; (5) equilibrium and growth models; (6) costs of environmental damage and management; (7) cost-benefit analysis for environmental design; (8) multi-objective optimization model; for decision making; (9) dynamic multi-objective modeling and environmental quality analysis; (10) optimal control of exhaustible resources; (11) multi-criteria analysis; (12) alternative approaches to uncertainty; and (13) urban problems, environmental profiles, and spatial mobility. (Bell-Graf-Cornell) W80-00027

**COMMENT ON 'VALUE OF INFORMATION IN RESERVOIR OPTIMIZATION' BY V. KLEMES.**

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
R. Krzysztofowicz.  
Water Resources Research, Vol. 15, No. 4, p 973-975, August 1979. 1 fig, 7 ref.

Descriptors: \*Reservoirs, \*Optimization, \*Value, \*Information, \*Asymptotic behavior, \*Uncertainty, Water resources, Management(Applied), Reservoir storage, Reservoir releases, Mathematical models, Systems analysis, Equations, Control law, Quadratic loss function, Loss minimization, Expected value criterion, Bayesian.

## Field 6—WATER RESOURCES PLANNING

### Group 6A—Techniques Of Planning

Reviewed is a paper by Klemes (1977) (See W78-02445) which branches a subject of considerable importance in the theory and practice of management of water resource systems. Clarification is made of a few points in Klemes' paper. In particular: (1) the asymptotic behavior of the optimal control law for a reservoir with a quadratic loss function is shown theoretically and its implications for Klemes' work are discussed; (2) Klemes' speculations on the dependence between the value of an increment of information and the system's complexity are questioned; and (3) an alternative Bayesian interpretation of the expected value criterion is given. (Bell-Graf-Cornell)  
W80-00147

#### PERSPECTIVES ON LAKE ECOSYSTEM MODELING.

For primary bibliographic entry see Field 2H.  
W80-00204

#### PREDICTIVE WATER QUALITY MODELS FOR THE GREAT LAKES: SOME CAPABILITIES AND LIMITS.

McMaster Univ., Hamilton (Ontario).  
For primary bibliographic entry see Field 2H.  
W80-00211

#### A MINIMUM-COST SURVEILLANCE PLAN FOR WATER QUALITY TREND DETECTION IN LAKE MICHIGAN.

Analytic Sciences Corp., Reading, MA.  
L. M. DePalma, R. P. Canale, and W. F. Powers.  
In: Perspectives on Lake Ecosystem Modeling, p 223-246, 1979. 1 fig, 6 tab, 20 eq, 27 ref, 1 append.

Descriptors: \*Water quality, \*Lake Michigan, \*Sampling, \*Cost minimization, \*Stochastic processes, \*Statistical methods, \*Model studies, \*Design, \*Trend detection, Optimization, Measurement, Long-term planning, Constraints, Systems analysis, Equations, Total phosphorus, Linear filter theory, Surveillance programs, Chloride, Cost effectiveness, Mass balance models, Concentrations, Kalman filter, Nonlinear stochastic difference equations, Uncertainty.

Developed is a systematic approach for designing least-cost sampling strategies for trend detection in large lakes. The uncertain parameters in a simple model for lakewide average concentrations of chloride and total phosphorus are characterized statistically. The model is interpreted as nonlinear stochastic difference equations which can be used, along with lake measurements, in a linearized Kalman filter. The approach uses statistical characterizations of mass balance models; the accuracy of the parameters in the mass balance models for lakewide average concentrations is examined for Lake Michigan. The combined procedures are used to determine the spatial and temporal frequency of sampling required to detect year-to-year trends. Minimum-cost surveillance plans are computed which meet accuracy criteria of the Kalman filter estimates. The analyses indicate that tributary samples are not a cost-effective source of information for estimating long-term lakewide average concentration, and that lake samples should be collected only for those years when the accuracy criteria must be satisfied. Furthermore, optimal cost for long-range trend detection is more sensitive to the accuracy of the phosphorus apparent settling velocity and of the laboratory analyses than to the accuracy of the effective Straits of Mackinac flow or the atmospheric loads. (See also W80-00204) (Bell-Graf-Cornell)  
W80-00213

#### BACKWATER AT BRIDGES AND DENSELY WOODED FLOOD PLAINS, TALLAHALA CREEK AT WALDRUP, MISSISSIPPI.

Geological Survey, Jackson, MS. Water Resources Div.; and Geological Survey, Montgomery, AL. Water Resources Div.; and Geological Survey, Baton Rouge, LA. Water Resources Div.  
B. E. Colson, C. O. Ming and G. J. Arcement.  
Available from Branch of Distribution, USGS 1200 S. Eads St. Arlington, VA 22202 price \$11.25. Geological Survey Hydrologic Investigations

Atlas HA-590, 1978. 9 sheets, 4 fig, 4 tab, 10 ref.

Descriptors: \*Flood data, \*Flood flow, \*Data collections, \*Model studies, \*Open channel flow, Streamflow, Peak discharge, Flood plains, Alabama, Louisiana, Mississippi, Flood profiles, Bridges, Backwater, Flow around objects, Streamflow forecasting, Analytical techniques, Vegetation, Embankments, Forest watersheds, Mannings equation, Digital computers, Evaluation, \*Tallahala Creek(MS).

Floodflow data that will provide a base for evaluating digital models relating to open-channel flow were obtained at 22 sites on streams in Alabama, Louisiana, and Mississippi. Thirty-five floods were measured. Analysis of the data indicated that backwater and discharges computed by standard indirect methods currently in use would be inaccurate where densely vegetated flood plains are crossed by highway embankments and single-opening bridges. This atlas presents flood information at the site on Tallahala Creek at Waldrup, Miss. Water depths, velocities, and discharges through bridge openings on Tallahala Creek at Waldrup, Miss., for floods of April 14, 1969, February 21, 1971, and April 13, 1974, were measured together with peak water surface elevations along embankments and along cross sections. Manning's roughness coefficient values in different parts of the flood plain are shown on maps, and flood-frequency relations are shown on graphs. (Woodard-USGS)  
W80-00241

#### MANAGEMENT ALTERNATIVES FOR SANTA CRUZ BASIN GROUNDWATER.

Arizona Univ., Tucson. Office of Arid Lands Studies.  
K. E. Foster.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 202-208, 3 fig, 10 ref.

Descriptors: \*Groundwater basins, \*Water management(Applied), \*Groundwater availability, \*Water resources development, \*Alternate planning, Sewage effluents, Water supply, Groundwater recharge, Water balance, Water shortage, Colorado River, Water sources, Municipal wastes, Water rights, Inter-basin transfers, Economic aspects, Political aspects, Water allocation(Policy), Water table, Southwest US, Arizona, River basins.

An analysis of current groundwater usage levels in the Santa Cruz Basin for agricultural, municipal, private, industrial and mining applications indicates an annual water balance deficit of 74,000 acre feet. Various techniques for reducing these current groundwater level declines including: (1) importing water from the Colorado River, (2) exchanging municipal sewage effluent with mines or farms for their fresh water rights, (3) interbasin transfers of water, (4) retiring farmlands for water rights and combinations thereof, are discussed here to illustrate the economic, political and physical aspects of developing this water source that must be considered. It is hoped that this discussion of the Santa Cruz River Basin, a typical example of the Basin-and-Range physiographic provinces in the southwestern U.S., will be applicable to most economically emergent urban areas in arid and semiarid regions. (Tickes-Arizona)  
W80-00296

#### MINNESOTA PEAT PROGRAM: MANAGEMENT GOALS AND OBJECTIVES AND POLICY ALTERNATIVES.

Minnesota Department of Natural Resources, April, 1979. 38 p. 2 append.

Descriptors: \*Peat, \*Minnesota, \*Regulation, Wetlands, Bogs, Marsh management, Management.

Policy statements are given which summarize the results of an evaluation of policy alternatives for peatland management. Detailed evaluations of policy issues including alternatives and justification for determining each policy are presented. (Steiner-Mass)

W80-00316

#### APPLYING PROBABILISTIC WATER QUALITY STANDARDS IN RIVER BASIN WATER QUALITY OPTIMIZATION MODELS.

Calgary Univ. (Alberta).  
M. B. Bayer.  
In: Water Pollution Research in Canada 1974. Incorporating the Proceedings of the 9th Canadian Symp. on Water Pollution Research, Western Ontario Univ., February 1974. J.E. Zajac and N. K. Saric, Eds., p 25-29. 3 tab, 2 eq, 20 ref.

Descriptors: \*Water quality, \*Standards, \*Probability, \*River basins, \*Dissolved oxygen, \*Biochemical oxygen demand, \*Nonlinear programming, Waste water treatment, Treatment facilities, Estimating, Optimization, Mathematical models, Equations, Systems analysis, Boundary values, Maximum likelihood, Cost minimization.

Described is a method of applying probabilistic dissolved oxygen (DO) and biochemical oxygen demand (BOD) standards in river basin water quality models. Maximum likelihood estimators for the DO and BOD concentrations variances for each reach are used to obtain a lower bound for BOD so that the probability of violating specified DO and BOD standards is less than 0 percent in any reach. These boundary values for DO and BOD concentrations are incorporated into a nonlinear water quality optimization model for finding the minimum cost set of wastewater treatment plant efficiencies required to meet DO and BOD standards. The method also provides the minimum DO concentration and the maximum BOD concentration which may be expected to occur 1-0 of the time for any reach. (Bell-Graf-Cornell)  
W80-00342

#### REAL-TIME PREDICTOR VERSUS SYNTHETIC HYDROLOGY FOR SEQUENTIAL RESERVOIR MANAGEMENT.

Milan Univ. (Italy). Ist. di Elettrotecnica ed Elettronica; and Centro Teoria dei Sistemi, Milan (Italy).  
G. Ambrosino, G. Fronza, and G. Guariso.  
Water Resources Research, Vol. 15, No. 4, p 885-890, August 1979. 5 fig, 2 tab, 14 eq, 20 ref.

Descriptors: \*Reservoir operation, \*Optimization, \*Stochastic processes, \*Real time, \*Sequential procedure, \*Predictor, Synthetic hydrology, Decision making, Reservoir releases, Reservoir storage, Dynamic programming, Computer models, Algorithms, Equations, Statistical method, Minimization, Systems analysis, Comparison, Inflow, Methodology.

This paper describes a sequential procedure for reservoir management and compares it with an existing method, the alternate stochastic optimization (ASO) method. Following the ASO approach, at each time step the decision on the release is based upon present storage, present and future target releases, and a number of 'possible' future inflows given by synthetic generation. In the approach described herein, the decision is also based on present storage and present and future targets, but the hydrological input is represented by the 'most likely' future inflow series, namely, by that inflow series forecast by a real time predictor (in the sense of Box and Jenkins). The management performance of the two methods is substantially the same, but the present procedure allows a very conspicuous computational saving. Actually, the optimization model (a dynamic program which gives the best decision) is run only once at each time step while it is run 20 or 30 times (depending upon the number of synthetic series used) in the ASO approach. (Bell-Graf-Cornell)  
W80-00361

#### OPTIMIZATION OF A DAM SYSTEM FOR RECHARGING RUNOFF WATER INTO THE GROUND.

Tahal Consulting Engineers Ltd., Haifa (Israel).  
For primary bibliographic entry see Field 4B.  
W80-00362

## Evaluation Process—Group 6B

**STOCHASTIC OPTIMIZATION OF A WATER SUPPLY SYSTEM.** Auckland Univ. (New Zealand). Dept. of Theoretical and Applied Mechanics. M. G. V. Bogle, and M. J. O'Sullivan. Water Resources Research, Vol. 15, No. 4, p 778-786, August 1979. 5 fig, 8 tab, 20 ref.

Descriptors: \*Stochastic processes, \*Water supply, \*Dynamic programming, \*Reservoir operation, \*Water policy, \*Cost minimization, Optimization, Constraints, Decision making, Reservoir releases, Reservoir storage, Inflow, Probability, Simulation analysis, Equations, Mathematical models, Systems analysis, Steady state, River-reservoir systems.

Stochastic dynamic programming (DP) is employed to derive the operating policy with the least expected steady state cost for a water supply system consisting of a reservoir and an alternative source. The set of possible decisions consists of a number of release rules, each expressing release as a function of storage, rather than a number of discrete releases, as in the conventional DP approach. A flexible procedure is developed which permits inflow to be described by piecewise linear probability density functions, and which removes the constraint that inflow and release must be multiples of the discrete unit of storage. The techniques are applied to a reservoir-river system, and through simulation, the results are compared with the solution found using conventional DP. (Bell-Graf-Cornell) W80-00397

## 6B. Evaluation Process

**THEORY AND APPLICATION OF ENVIRONMENTAL ECONOMICS.** Vrije Univ., Amsterdam (Netherlands). For primary bibliographic entry see Field 6A. W80-00027

**AN ECONOMIC AND ENVIRONMENTAL EVALUATION OF ALTERNATIVE LAND DEVELOPMENT AROUND LAKES.** New Hampshire Univ., Durham. Inst. of Natural and Environmental Resources. J. A. Pickering, and R. A. Andrews. Water Resources Bulletin, Vol. 15, No. 4, p 1039-1049, August 1979. 4 fig, 2 tab, 4 ref. OWRT A-038-NH(3). 14-31-0001-4029.

Descriptors: \*Evaluation, \*Alternative planning, \*Land development, \*Lakes, \*New Hampshire, Water quality, Phosphorus, Eutrophication, Environmental effects, Economic impact, Residential patterns, Commercial patterns, Land use, Equations, Simplex linear programming, Constraints, Revenue maximization, Water policy, Optimization, Zoning.

Reported herein is a study which made an evaluation of alternative land developments around New Hampshire lakes. Alternative development patterns, evaluated by their impacts on the lake area environment and area economy, included residential patterns, commercial patterns, and combinations of these two types. Phosphorus loading of the lake water was used as a proxy variable for changes in the lake water quality. Commercial developments yielded the highest revenues to the town and the local area. It also attracted the most lake users to the area as well as contributing the largest phosphorus loading in the lake waters. Residential developments, although contributing high revenues to the businessmen in the area, yielded less net income to the town. Phosphorus loading levels from residential developments were much lower than lake phosphorus loading by commercial developments. (Bell-Graf-Cornell) W80-00148

**MODELING MANAGEMENT OF PONDEROSA PINE FOREST RESOURCES.** Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ. For primary bibliographic entry see Field 2A. W80-00228

**ECONOMIC ASSESSMENT OF POTENTIAL HAZARDOUS WASTE CONTROL GUIDELINES FOR THE INORGANIC CHEMICALS INDUSTRY.** Little (Arthur D.) Inc., Cambridge, MA. R. Williams, R. Shamel, K. Hallock, B. Stangle, and S. Blair. Available from the National Technical Information Service, Springfield, VA 22161 as PB-263 210. Price codes: A14 in paper copy, A01 in microfiche. Report EPA/530/SW-134c, 1976. 320 p, 6 fig, 130 tab, 2 append.

Descriptors: \*Economic impact, \*Econometrics, \*Chemical industry, \*Regulation, \*Waste treatment, Water pollution sources, Inorganic compounds, Elasticity of demand, Prices, Hazards.

The economic impact of potential hazardous waste management regulations on the inorganic chemicals industry was analyzed. Inorganic chemicals considered included chlorine and caustic soda, hydrofluoric acid, elemental phosphorus, sodium dichromate, titanium dioxide, aluminum fluoride, chrome pigments, nickel sulfate, phosphorus pentasulfide, phosphorus trichloride, and sodium silicofluoride. The analysis was based on hazardous waste management cost data supplied by the EPA. The defraying of hazardous waste management costs through price increases or the possibility of plant closure due to the cost of management were assessed. Impacts on chemical production were estimated using econometrically-derived demand elasticities. Only hydrofluoric acid would experience a decrease in demand enough to possibly cause plant closures. A 1.6 drop in demand due to higher prices or a 2.9 million dollar drop in sales was projected for hydrofluoric acid. (Small-FRC) W80-00249

**REGIONAL ANALYSIS OF ECONOMIC ACTIVITY, RESOURCE MANAGEMENT AND LAKE EUTROPHICATION: CASE STUDY OF ITASCA COUNTY, MINNESOTA.** Minnesota Univ., St. Paul. Coll. of Forestry. For primary bibliographic entry see Field 5C. W80-00254

**TUCSON'S TOOLS FOR DEMAND MANAGEMENT.** Arizona State Water and Sewer Dept., Tucson. S. E. Davis. In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, April 14-15, 1978, Flagstaff, Az. Vol. 8, p 9-15, 2 tab, 2 fig, 3 ref.

Descriptors: \*Water demand, \*Project post-evaluation, \*Water allocation(Policy), \*Municipal water, Water management(Applied), Alternate planning, Capital costs, Comprehensive planning, Water consumption(Except consumptive use), Tucson, Arizona.

Tucson, Arizona's 'Beat The Peak' management program initiated on June 1, 1977 is described here to demonstrate how peak management has successfully played an important role in the provision of municipal water resources. Designed to reduce peak water use and facilitate the deferral of costly capital improvements otherwise required, the program has effectuated a reduction in peak day water usage from 151.5 million gallons per day on July 9, 1976 to 114.0 million gallons per day on July 8, 1977. The elements of the program which were a voluntary alternate day outdoor watering program utilizing customer address and date and a voluntary limitation of outdoor watering between 4 and 8 in the afternoon, the utilities hours of highest demand, have led to a 25% reduction in summer usage by the single family class since 1974 and of 15% since 1976. Although the program continues to be a success, areas in which major policy and technical questions remain are listed and discussed. (Tickes-Arizona) W80-00270

**MODEL FOR SELECTION OF STORMWATER CONTROL ALTERNATIVES.**

Toronto Univ. (Ontario). Dept. of Civil Engineering. R. Bedrosyan, and J. Gancarczyk.

In: Water Pollution Research in Canada 1977. Incorporating the Proceedings of the Twelfth Canadian Symp. on Water Poll. Research, Univ. of Toronto, Feb. 1977 and Eastern Div. Symp., Concordia Univ., Montreal, Dec., '76, p 1-25. 9 fig, 2 tab.

Descriptors: \*Water pollution control, \*Computer models, \*Simulation analysis, \*Real-time control, \*Alternative planning, \*Combined sewers, \*Storm runoff, \*Cost effective, Performance, Monitoring, Overflow, Treatment facilities, Water resources, Urban runoff, Management, STORM model, RAFFI model, Estimating, Operations research.

Real-time control is a cost-effective pollution abatement alternative, and the computer model RAFFI can be used to evaluate this in the initial planning stage. Despite high initial cost, real-time control helps to use all components of an existing system effectively; moreover, it can be implemented readily in most major combined sewer cities without requiring additional facilities. Despite limitations and simplistic assumptions, RAFFI can be useful when interfaces with STORM in the initial planning stage of a stormwater management study, wherein the behavior of an existing system and all alternative abatement methods can be estimated with a simple, inexpensive continuous simulation model such as STORM-RAFFI over a long period. This will provide a starting point and help to screen a large number of alternatives at low cost. When the number of alternatives is reduced, those more effective ones can be studied with more detailed and expensive models such as WREM. An example given to indicate the potential for STORM-RAFFI shows that simulation with WREM on the Winnipeg study area would cost \$300 to \$400/run for a single 6-hour critical event with surcharged conditions; output would be very detailed overflow hydrographs, water depths, height of surcharge, etc. The study with STORM-RAFFI would cost only \$15 to \$20/run for a continuous six month record, yielding much useful information to the decision maker about real-time control or overflow treatment alternatives. (Bell-Graf-Cornell) W80-00318

**A WATER QUALITY ECONOMIC INDEX.** Department of the Environment, Ottawa (Ontario). Inland Waters Directorate. W. M. Keilani, R. H. Peters, and P. J. Reynolds. In: Water Pollution Research in Canada 1977. Incorporating the Proceedings of the 9th Canadian Symp. on Water Pollution Research, Western Ontario Univ., February 1974. J.E. Zajac and N. Kossaric, Eds., p 1-24. 8 tab, 8 equ, 9 ref.

Descriptors: \*Methodology, \*Water quality, \*Indices, \*Economics, \*Statistical methods, \*Mathematical models, Evaluation, Decision making, Regional analysis, Equations, Systems analysis, Damage coefficient, Bivariate use, Trends, Laspeyre's formula, Additive model, Multiplicative model, Relative use weights, Parameter rating.

A methodology is presented for producing a water quality economic index which will provide information on the direction and amount of change in water quality on a regional and national basis. It will be useful for evaluation of water quality trends and for economic decision making regarding preventive measures and treatment programs. The methodology consists of statistical and mathematical models, supported by tables, for the different steps in calculating the indices. Two sample indices derived from actual and estimated data are also given. The method utilizes an adaption of Laspeyre's weighted aggregate formula which employs base year weights for construction of indices. Five water quality parameters are assigned to each of twelve water uses. Each parameter value, measured at the actual or potential point of use, is rated between a 'desired objective' of 0 and a 'maximum permissible level' of 100. Each parameter is then given a relative weight out of a total weight of unity to reflect its importance to the use. Relative economic weights for all uses are derived by means

## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

of a damage coefficient. Segments of the index are combined where parameters are common to more than one use, and a bivariate use and parameter economic index is constructed. A set of subgroup bivariate indices by both use and individual parameters is also produced to allow for quality trend evaluation. (Bell-Graf-Cornell)  
W80-00346

### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**THE POTENTIAL ECONOMIC USES OF HALOPHYTES.**  
Scriptis Institution of Oceanography, La Jolla, CA. Foundation for Ocean Research.  
P. J. Mudie.

In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.), Academic Press, Inc., New York, p 565-597, 1974. 1 fig, 5 tab, 121 ref.

Descriptors: \*Marsh plants, \*Halophytes, \*Economics, \*Value, Wetlands, Agriculture, Marshes, Benefits, Salt marshes, Natural resources, Food and cover crops, Marsh management.

Halophytes that have some present direct economic value (other than local use for sand-binding or marsh reclamation) are listed along with their reported ranges of salt tolerance and/or their estimated tolerance. Halophytes with minor, subsistence-level uses in restricted areas and those with historical food or medicinal uses are listed in another table. This table also includes halophytes with characteristics that appear to make them suitable for some economic purpose. Most of the species represent incompletely evaluated resources and only tenuous judgments can presently be made concerning their potential usefulness. (Steiner-Mass)  
W80-00040

### 6D. Water Demand

**WATER CONSERVATION AND ALTERNATIVE WATER SUPPLIES, PROCEEDINGS OF A SOUTHEAST REGIONAL CONFERENCE NOVEMBER 8-9, 1978 AT THE GEORGIA INSTITUTE OF TECHNOLOGY.**

Available from the National Technical Information Service, Springfield, VA 22161 as PB-301 269, Price codes: A10 in paper copy, A01 in microfiche. Environmental Resources Center, Georgia Institute of Technology, Atlanta. Report ERC 04-79 July 1979. 224 p. J.R. Wallace and B. Kahn, editors. OWRB B-123-NC(4) 2nd OWRB B-125-NC(4). 14-34-0001-9144, 14-34-0001-8134.

Descriptors: \*Water conservation, \*Water supply, Water demand, Water reuse, Water allocation.

The proceedings of the second in a series of conferences held by the water research institutes and water resources management agencies in the South Atlantic Gulf States are compiled. In this conference, present and emerging conflicts for available water supplies were described, alternative sources of water supply were examined, opportunities were considered for extending existing supplies, and courses of remedial action were recommended to assure adequate water supplies. Eighteen papers by separate authors review current and near-term water supply-demand problems in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia; discuss the President's water policy study; consider alternative water sources; and recommend approaches to more efficient water use in industry, agriculture, and municipalities.  
W80-00001

**FACTORS FOR PREDICTING COMMERCIAL WATER USE.**

Metcalf and Eddy, Inc., Boston, MA.  
J. R. Kim, and R. H. McCuen.

Water Resources Bulletin, Vol. 15, No. 4, p 1073-1080, August 1979. 3 tab, 1 eq, 3 ref. OWRB A-025-MD(4). 14-31-0001-5020.

Descriptors: \*Water demand, \*Water utilization, \*Prediction, \*Principal components analysis, Data collection, Multiple correlation analysis, Equations, Planning, Estimating, Methodology, Systems analysis, Mathematical models, \*Commercial water use.

Growth in the commercial sector of the economy and the increased importance of total waste water volumes in design have created a need for methods of estimating commercial water demand. The results of a multiple correlation analysis and a principal components analysis suggest that commercial water demand is a function of the following three primary constructs: an employee water use factor, a customer layout factor, and a customer water facility factor. Three easily measured variables were used to represent these major constructs: gross store area, length of display windows, and the number of drinking fountains, respectively. Prediction equations relating water use and the three variables were derived and can be used by planners in estimating commercial water use. (Bell-Graf-Cornell)  
W80-00203

### 6E. Water Law and Institutions

**PROCEEDINGS, URBAN STORMWATER MANAGEMENT SEMINARS, ATLANTA, GEORGIA, NOVEMBER 4-6, 1975 AND DENVER, COLORADO, DECEMBER 2-4, 1975.**  
For primary bibliographic entry see Field 4A.  
W80-00043

**PLANNING TO NARROW THE IMPLEMENTATION GAP.**  
Municipality of Metropolitan Seattle-METRO, WA.  
For primary bibliographic entry see Field 4A.  
W80-00067

**STATUS OF EPA'S EFFLUENT GUIDELINES FOR THE FOOD INDUSTRY.**  
Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.  
J. D. Denit, and E. H. Forsht.  
In: Proceedings of 8th National Symposium on Food Processing wastes, March 30-April 1, 1977, Seattle, Washington, p 9-19. 1977. 3 tab, 17 ref.

Descriptors: \*Regulation, \*Federal water pollution control act, \*Food processing wastes, \*Water reuse, Recycling, Legislation, Industrial wastes, Legal aspects.

The Environmental Protection Agency's promulgated regulations covering about 28,000 point sources within the food processing industry are discussed. The legal status of the regulations is reviewed, and food industry studies are reviewed. Legal issues include jurisdiction, and ranges of limitations for certain plants versus national uniform standards. Influences and constraints which may affect food processing regulation include the energy shortage and other environmental legislation. The requirements of the Federal Water Pollution Control Act Amendments (PL 92-500) and other environmental legislation have sparked interest in the recovery reuse, and conservation of process wastes and water. There is an increasing trend toward by-product recovery, reuse, recycle, and water conservation, along with end-of-pipe treatment. (See also W80-00116) (Small-FRC)  
W80-00117

**WATER QUALITY MANAGEMENT ACCOMPLISHMENTS COMPENDIUM I.**

Environmental Protection Agency, Washington, DC. Water Planning Div.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-275 631, Price codes: A06 in paper copy, A01 in microfiche. Report EPA-440/3-77-026, 1977. 117 p, 1 tab.

Descriptors: \*Water quality control, \*Administrative agencies, \*Legal aspects, \*Federal Water Pollution Control Act, \*Local governments, Municipal

pal wastes, Industrial wastes, Waste disposal, Regions, Waste water treatment, Waste water disposal.

Case studies of 58 programs in various states for water quality management, initiated under Section 208 of P.L. 92-500, are cited. The cases are categorized as either accomplishments, indicating formally adopted or implemented programs, or performance indicators, in which water quality management programs have received preliminary commitment but have not been implemented. The four major problem areas addressed by water quality agencies are nonpoint sources, on-lot disposal, industrial point sources, and municipal point sources of pollution. The case studies are cited by state and region of location. (Lisk-FRC)  
W80-00242

**ARIZONA GROUNDWATER LAW REFORM - AN URBAN PERSPECTIVE.**

Arizona State Water and Sewer Dept., Tucson.  
H. Holub.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, April 14-15, 1978, Flagstaff, Az., Vol. 8, p 16-23, 15 ref.

Descriptors: \*Groundwater, \*Water law, \*Legal aspects, \*Arizona, \*Water management (Applied), \*Urban hydrology, Constraints, Groundwater availability, Comprehensive planning, Political aspects.

Existing Arizona groundwater law, it is contended, does not provide for effective management of groundwater resources. Accordingly, several reforms are proposed to more effectively handle urban water problems under the present laws. These include: (1) a re-evaluation of existing preferences and subsidies which encourage the mining of groundwater, (2) an extraction tax to recognize public costs associated with groundwater mining and the need for replenishment, (3) a method of quantifying existing rights and measuring use of groundwater, (4) an effective system of management which considers differing types of water problems in various parts of the state, (5) a permanent mechanism to permit transfer of water rights away from specific parcels of land, and (6) a comprehensive set of regulations on groundwater use to enhance the public interest. The definitions of the problems, issues, goals and solutions of Arizona's water resource future are as diverse as the interested parties. It follows therefore that the one problem which continues to stymie all attempts to solve the State's water resource problem is the unwillingness of the various competing interests to try seriously to work out a common solution. The failure to solve the problem, it is argued, increases the possibility of federal interventions in State water management. (Tickes-Arizona)  
W80-00271

**LEGAL ASPECTS OF URBAN RUNOFF DEVELOPMENT.**

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
D. A. Chudnoff.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 182-184, 9 ref.

Descriptors: \*Legal aspects, \*Legal review, \*Water law, \*Urban hydrology, \*Urban runoff, Equitable apportionment, Competing uses, Water resources development, Constraints, Appropriation, Surface runoff, Developed waters, Planning.

The relationships between the separate disciplines of hydrology and law are analyzed in this study into how water law and its strictures may impose upon the development of urban runoff in the metropolitan Tucson area. Brief descriptions of the doctrine of appropriation, diffuse surface waters and developed waters are presented to illustrate

the complexities of the problem of urban runoff development. It is suggested that planners must not only be aware of the legal issues involved but also must understand the philosophy and principles of water law. (Tickes-Arizona)  
W80-00293

#### PEATLAND POLICY STUDY,

Minnesota Univ.-Duluth.  
W. A. Fleischman.  
Minnesota Department of Natural Resources, July, 1978. 98 p. 2 fig, 20 tab, 103 ref, 5 append.

Descriptors: \*Peat, \*Census, \*Regulation, Wetlands, Production, Management, Marsh management, Legislation, Legal aspects, State governments.

The findings of this study are based on questionnaires mailed to the Natural Resource Department, State Geological Survey Director, and State Conservationist in each of the states and Puerto Rico. The study considers four major substantive areas related to peatland management: (1) peatland policies, (2) production, (3) future, and (4) peatland information and committee activity. The two major considerations regarding policy are the legal status of peatlands and the mechanisms for regulating peatlands. When given a specific and separate legal status, peat is often considered a mineral. The regulation of peatlands is based on a wide variety of legislative acts including surface mining laws, mining acts, wetland laws, mined land reclamation acts, environmental quality acts, and local zoning ordinances. The commercial operations producing peat are for the most part on private land. The peat that is extracted commercially in the peat production states includes peat of the major types: Sphagnum, reed sedge, and peat humus. Only eight states indicated that peat was a significant resource in that state. The major conclusion of the study is that peat management policy is in the early stages of development. (Steiner-Mass)  
W80-00317

#### THE QUIET BEFORE THE SHOOTOUT OVER THE WATER LAW OF THE WEST,

D. Kirschen.  
National Journal, Vol. 10, No. 4, p 149-53, January 28, 1978.

Descriptors: \*Irrigation programs, \*Federal project policy, \*Political constraints, Water law, Political aspects, Irrigated land, Irrigation practices, Irrigation systems, Irrigation district, Federal-state water rights conflict.

The Carter Administration has proposed regulations that would limit the liberal water welfare benefits to western resident family farmers in accordance with the intent of the 1902 Reclamation Act. This vulnerable blueprint for western irrigation has been changed little by Congress since 1902. The Interior Department is under court order to prepare an environmental impact statement on the proposed rules, a process that will take at least a year. In a message to Congress, President Carter suggested that water pricing policies in the West encourage wasteful consumption. He cited a study showing that over half of the water delivered through Bureau of Reclamation irrigation systems is completely wasted. The President's answer is wise management and conservation, not expensive new water projects. A federal court has ordered the Administration to address the family farming mandates of the reclamation law. Only Congressional action can change that law. Carter has managed to elevate the water projects issue from a matter of parochial politics to one of national concern. The President's basic question on the economics and equities of public financing of water projects has yet to be answered. (Coffey-Florida)  
W80-00360

#### PRELIMINARY ANALYSIS OF LEGAL OBSTACLES AND INCENTIVES TO THE DEVELOPMENT OF LOW-HEAD HYDROELECTRIC POWER IN THE NORTHEASTERN UNITED STATES,

Franklin Pierce Law Center, Concord, NH.

P. W. Brown, and A. W. Buxton.  
Available from the National Technical Information Service, Springfield, VA 22161 as DOE/RA-23-216.00-0-01, Price codes: A05 in paper copy, A01 in microfiche. Report DOE/RA-23-216.00-0-01, Sept. 1978 (Revised March 1979), 75 p.

Descriptors: \*Damsites, Hydroelectric plants, \*Hydroelectric project licensing, Dams, Federal jurisdiction, State jurisdiction, Energy, Legal aspects, Regulation, Regional analysis.

The statutes and case law of 19 states and the Federal Government which affect developers of small dams are analyzed. The legal uncertainty and regulatory burdens which confront the developer are reported. For ease of analysis, the mythical state of Hydrovania is described. Hydrovania represents many of the common features of all the states under study. No final conclusion is reached concerning the nature of impact of any particular law or doctrine on small dam developers. Regional approaches and solutions to the problem of increasing the rate of small dam development will have some success. Experiments in one state will be useful information for activities in another state. Other problems, to be examined in subsequent reports, and not discussed here include: (1) the institutional obstacles and incentives to small dam development; (2) the access to capital and capital markets by developers; and (3) the relationship between dam owners and riparian owners. There is a flow diagram illustrating federal regulation of small dams. (Coffey-Florida)  
W80-00363

#### THE ROLE OF THE PERMIT SYSTEM IN THE CALIFORNIA COASTAL STRATEGY,

R. G. Healy.  
In: Protecting the Golden Shore (Lessons from the California Coastal Commissions), Healy, R.G., ed., p 67-95, The Conservation Foundation, Washington, D.C., 1978.

Descriptors: \*California, \*Coasts, \*Permits, \*Land use, Planning, Resource allocation, Building codes, Water policy.

How the permit system, as originally conceived and later administered, influenced California's final objective of feasible coastal plan is discussed. The permit process set out in Proposition 20 was not meant to be the final step, but the first of three phases: (1) a four-year interim permit system; (2) the preparation of a coastal plan; and (3) the acceptance of a plan by the state legislature. As designed by the coastal initiative's authors, the permit process was to have a complex relationship to the other two phases. First, the state commissions were to use permit authority to protect coastal resources during the interim period while the plan was being prepared. Second, the process would provide information on coastal issues and possible policies, resulting in a better plan. Third, the permit process would generate interest and support for legislative adoption of a permanent system of coastal controls. How well the integration of the permit process and planning worked in reaching each of these three objectives is discussed. On balance, California's strategy was a highly successful one. (Coffey-Florida)  
W80-00364

#### THE COASTAL COMMISSIONS AND STATE AGENCIES: CONFLICT AND COOPERATION,

J. S. Banta.  
In: Protecting the Golden Shore (Lessons from the California Coastal Commissions), Healy, R.G., ed., p 97-131, The Conservation Foundation, Washington, D.C., 1978.

Descriptors: \*California, \*Coasts, \*Permit, \*Land use, Planning, Regulation, Environmental control, Resources, Governments, Water law, Legislation, Coastal engineering.

The passage of Proposition 20 proved overwhelming that most Californians did not believe that existing state and local actions regarding pollution, the park system, and land-use planning were adequately

protecting coastal values. The initiative gave the California coastal commissions a clear directive. They had final and near-absolute authority over the location and type of development near the coast. The commissions could prohibit a proposed development or impose strict conditions, even though the project had previously received other state or local approvals to begin construction. Even when a state agency was the developer, as in highway projects, it too was required to secure a permit from the coastal commissions. An extensive overview is presented of the California coastal commissions and how they worked. The coastal commissions were an emergency response to bureaucratically confused environmental priorities. The most significant institutional impact of the commissions was to cause state agencies to see the coast as a geographic entity, rather than simply in terms of their own functions. Alternatives to the commission approach are discussed. (Coffey-Florida)  
W80-00365

#### THE ANGLO-FRENCH CONTINENTAL SHELF CASE,

University of Wales Inst. of Science and Technology, Cardiff.  
E. D. Brown.  
San Diego Law Review, Vol. 16, No. 3, p 461-530, 1979.

Descriptors: \*International law, \*Continental shelf, \*Boundary disputes, Judicial decisions, International arbitration, United Nations, Geneva convention, Law of the sea, Legal aspects, Regulation, Governments.

The longstanding dispute between France and England over the delimitation of their respective continental shelves was recently put to a court of arbitration. The Court's holding, the boundary lines laid down by the Court and the impact of that decision are discussed. The dispute is only the second continental shelf boundary question settled in a judicial arena, and the first involving parties to the Geneva Convention on the Continental Shelf. For these reasons, the case will be carefully scrutinized by those involved in similar disputes. Canada and the United States are in disagreement over the boundaries in the Gulf of Maine. The Third United Nations Conference on the Law of the Sea could render the court's decision of only transitional importance, if the Conference delivers a clear, workable formula for the delimitation of the continental shelf between neighboring states. (MacGregor-Florida)  
W80-00366

#### FRESHWATER AND THE FLORIDA COAST: SOUTHWEST FLORIDA,

Proceedings of a Seminar for the Southwest Florida Water Management District, May 26-27, 1977, Tampa, Florida, Sea Grant College Program Report Number 22, Southwest Florida Water Management District, Brooksville, Report No. 1977-1, Oct 1977. 244 p, 3 append.

Descriptors: \*Estuaries, \*Freshwater, \*Water management (Applied), \*Southwest Florida Water Management District, Water policy, Water utilization, Water districts, Water resources, Water supply, Economics, Ecosystems, Environmental engineering, Estuarine environment, Estuarine fisheries.

Freshwater use in the Southwest Florida Water Management District is analyzed from economic, engineering and biological perspectives. The papers include: (1) The Coastal Zone: Multi-Use Resource Allocation and Institutional Failure; (2) Economics of Water Problems; (3) Development and the Hydrology and Geohydrology of Coastal Drainage Basins; (4) A Review and Evaluation of Selected Numerical Models for Coastal Zone Water Management; (5) Freshwater and the Florida Coast: Review and Update; (6) Groundwater Flow; (7) The Marine Ecosystem From an Engineering Viewpoint; (8) The Role of Freshwater in an Estuary; (9) The Estuary - What's It to You; (10) The Estuary Viewed as a Dynamic System; and (11) Some Relationships between River Flow,

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

Estuarine Characteristics, and Economics in a Florida Gulf Coast Region. Bibliographies are included. (MacGregor-Florida)  
W80-00367

**INTERNATIONAL ENVIRONMENTAL IMPLICATIONS OF SOVIET DEVELOPMENT OF THE VOLGA RIVER.**  
Western Michigan Univ., Kalamazoo.  
P. P. Micklin.  
Human Ecology, Vol. 5, No. 2, p 113-135, June 1977.

Descriptors: \*River basin development, \*River regulation, \*International law, River flow, Environmental effects, International commissions, United Nations, Water allocation(Policy), Legal aspects, Water supply.

Hydrological alteration of major rivers may cause international environmental disturbance. The development of the Volga River by the Soviet Union is used to illustrate the problem. The most immediate victim of Volga development is Iran, which borders on the Caspian Sea. The Volga, a tributary of the sea, has had its natural flow changed by the development. This change has damaged the Caspian and thereby Iran. Proposed plans to alleviate problems in the Caspian Sea would clearly have global effects. The international problems associated with Soviet development of the Volga are not unique, and concern all governments. An American example is the use of the Colorado River by the United States to the detriment of Mexico. Suggested solutions include: (1) an 'international environmental impact statement' modeled on the provisions of the United States National Environmental Policy Act; (2) an International Environmental Agency; and (3) involvement of United Nations organizations. (MacGregor-Florida)  
W80-00368

**LOCAL GOVERNMENT RESPONSE TO STATE-MANDATED LAND USE LAWS,**  
Oregon State Univ. Corvallis.  
B. A. Weber, and K. S. Peroff.  
Journal of the American Institute of Planners, Vol. 43, No. 4, p 352-60, October 1977.

Descriptors: \*Wisconsin, \*Shore protection, \*Land use, Shores, Coasts, Zoning, Regulation, Local governments, Legal aspects, Land management.

In 1966, the Wisconsin legislature passed one of the nation's first Water Resources Acts. The shore land provisions of the Act and the effect they had on county governments are discussed. The Act required counties to enact a land use control package for shore land. The package included zoning, dredge and fill regulations, and standards for wells and septic tanks. County regulations were required to meet or exceed the minimum standards of the package. An important aspect of the Act was the elimination of a town's veto power over county shore land zoning. The Act's shore land provisions have spurred counties to institute control over all use of unincorporated land, whether or not it borders on water. (MacGregor-Florida)  
W80-00369

**COASTAL HAZARDS AND NATIONAL POLICY: A JURY-RIG APPROACH,**  
Massachusetts Univ., Amherst.  
R. H. Platt.  
Journal of the American Institute of Planners, Vol. 44, No. 2, p 170-80, April 1978.

Descriptors: \*Coastal zone management, \*Flood plain insurance, \*Flood plain zoning, Administrative agencies, Coastal structures, Coasts, Regulation, Executive orders, Flood forecasting, Flood control, National seashores.

Nearly half of the people in the United States live in counties which border on a shoreline. They are subjected to a variety of coastal hazards, most notably, hurricanes, floods and erosion. Despite these dangers, the federal government lacks a unified policy in this area. Some specific elements of

the 1972 Coastal Zone Management Act (CZM) which necessitate consideration of natural hazards are: (1) delineation of coastal zones; (2) permissible land and water uses; (3) areas of particular concern; and (4) state management techniques. The Act lacks substantive standards. Key aspects of the National Flood Insurance Program (NFIP) relevant to coastal zone management are: (1) mapping; (2) coastal high hazard areas; (3) erosion; and (4) permits. The NFIP contains specific national objectives and has begun to achieve favorable results, although it is complicated, unwieldy and controversial. Some helpful executive orders are examined. Two recent ones issued by President Carter provide a detailed policy which, when combined with the CZM and NFIP, will provide a national policy for coastal zone hazard management. (MacGregor-Florida)  
W80-00370

**ALASKA NATIVE WATER RIGHTS AS AFFECTED BY THE ALASKA NATIVE CLAIMS SETTLEMENT ACT,**  
K. Stoeber, V. Camerino, and S. Nickeson.  
American Indian Journal, Vol. 4, No. 3, p 2-26, March 1978. 3 append.

Descriptors: \*Alaska, \*Indian reservations, \*Water rights, Indians, Federal government, Judicial decisions, Water utilization, Water supply, Water allocation(Policy), Riparian rights, Prior appropriation.

While water is relatively abundant in Alaska, there are problems of quality, distribution, and the important question of the water rights of the Alaskan Indians. The importance of water to the Alaskan natives and the effect of the Alaska Native Claims Settlement Act (ANCSA) has had on the water rights of these people are discussed. The problem of defining native water rights into one of at least three possible categories - riparian, prior appropriation, or federal reserve rights - is examined. The potential importance of an upcoming native water rights case, *Paug-Vik v. Guy Martin*, the Alaskan Water Use Act and the National Interest Lands Bill is considered. The question of native water rights needs quick and final resolution. Competition for water resources can only increase as the commercial development of Alaska continues. A strong legal claim exists for retained Native water rights on Native selected lands. Water rights are critical to the maintenance of Native subsistence economics and continued commercial developments. (MacGregor-Florida)  
W80-00371

**RESPONSE TO GAO WATER REPORT.**  
American Indian Journal, Vol. 4, No. 8, p 40-45, August 1978.

Descriptors: \*Indian reservations, \*Water rights, \*Federal reservations, Administrative agencies, Legislation, Water supply, Water resources, Federal government, Water allocation(Policy), Legal aspects, Water conservation.

The Government Accounting Office (GAO) has issued a report entitled 'Water Rights Reserved for Federal and Indian Reservations: A Growing Controversy in Need of Resolution.' This is a summary of responsive reports by the National Congress of American Indians and the Colville Confederated Tribes. Omissions and inaccuracies in the GAO document are divulged. The GAO conclusions place the burden of loss on the Indian tribes without recognizing the federal government's responsibility for water problems in the western reservations. The GAO report also ignores Indian rights to compensation under the Fifth Amendment for water rights lost by government action. Ten recommendations are given, by the Congress, chief of which is that the GAO report not be issued. The Colville summary sees greed and corruption as the reason for Indian relinquishment of their water rights. The Colville report seeks judicial rather than legislative answers to their water rights problems. Colville also recommends non-issuance of the GAO report. (MacGregor-Florida)  
W80-00372

**NCAI TO GAO: LEGISLATIVE QUANTIFICATION OF INDIAN WATER RIGHTS IS NOT THE ANSWER.**  
American Indian Journal, Vol. 5, No. 1, p 33-36, January 1979.

Descriptors: \*Indians, \*Water rights, \*Indian reservations, State governments, Water policy, Administrative agencies, Water supply, Federal reservations, Water demand, Water resources, Legal aspects.

This is the National Congress of American Indians' response to the Government Accounting Office's report to Congress, and Indian Reservations: A Growing Controversy in Need of Resolution. Native Americans have been continually forced to defend their land and water from white appropriation for development purposes. The GAO report presumes the major problem with western water supply is the unquantified nature of the federal and the Indian reserved rights. The real problem is there is very little water in the West, and non-Indian interests are unwilling to establish any ceiling on their water use. The development of western non-Indian water uses in complete disregard of known Indian tribes water rights claims constitutes a callous and inexcusable breach of fiduciary duties by the trustee, United States. The GAO conclusions place the burden of compromise and loss upon Indian tribes. The GAO report is so incomplete and inadequate that the Comptroller General should be requested not to publish it. Recommendations regarding western water policy and Indian reserved rights should be considered. (Ewing-Florida)  
W80-00373

**NCAI'S EXECUTIVE COUNCIL MEETING AND INDIAN WATER RIGHTS.**  
American Indian Journal, Vol. 5, No. 2, p 35-38, February, 1979.

Descriptors: \*Water rights, \*Indians, \*Indian reservations, Water policy, Federal government, Water resources, Constitutional law, Federal budget, Legal aspects, Water law, Federal reservations.

Recent federal actions pressuring or threatening to pressure Indians to quantify their water rights were discussed. The National Congress of American Indians (NCAI) stated that Indian rights to use of water are invaluable interests in real property; full equitable title to which resides in the tribes. The rights are private in character and protected against violation by the Fifth Amendment. It is the obligation of the United States government, as trustee, to rigorously adhere to the distinction between Indian and federal rights. The tribes have the full authority to administer, control and allocate the water resources on their reservations. The NCAI also adopted resolutions pertaining to: (1) required consent of tribes on all federal actions affecting Indian water rights; (2) funding for consultation with tribes and employment of Indian counsel; (3) development of criteria for land classification; (4) successors to Indian lands; (5) amendment of the McCarran amendment; (6) Indian water projects; (7) United States vs. tribes; (8) tribal participation in governmental water law commissions; and (9) no quantification of Indian rights. (Ewing-Florida)  
W80-00374

**WHO WILL REAP THE MINERAL RICHES OF THE DEEP,**  
S. G. Slappey.  
Nation's Business, Vol. 66, p 24-28, 32, March, 1978.

Descriptors: \*International law, \*International waters, \*Resources development, United Nations, Natural resources, Mineral industry, Foreign countries, Mining, Water policy, Beds under water, Environmental effects.

There is an area of the Pacific between Hawaii and Mexico, approximately 2600 miles long and 800 miles wide, where the sea bed has billions of ore-rich nodules. For centuries, the world has recog-

## Water Law and Institutions—Group 6E

ANTIFICATION  
IS NOT

1, p 33-36,

\*Indian res-  
policy, Ad-  
Federal reser-  
vations, Legal

Indian Indians'  
nting Office's  
ervations: A  
Resolution.  
ally forced to  
ite appropri-  
GAO report  
western water  
e federal and  
l problem is  
est, and non-  
lish any ceil-  
ment of west-  
disregard of  
ns constitutes  
lucary duties  
GAO conclu-  
is so incom-  
oller General  
Recommend-  
y and Indian  
(Ewing-Flor-  
ida)

WATER RIGHTS: THE ISSUE AND THE  
COURTS.  
L. Anderson.  
Akwasene Notes, Vol. 9, No. 4, p 28-29, September 1977.

Descriptors: \*Federal reservations, \*Indian reser-  
vations, \*Indians, \*Water rights, Water supply,  
Water policy, Judicial decisions, Water law, Water  
resources, Federal government, Federal-state  
water rights conflict, Constitutional Law.

Natural resources, including water are becoming  
important and prominent political, cultural, and  
legal issues, especially in the western states where  
water means the difference between arable land and  
desert. Indian water rights are based primarily on  
this concept: when the federal government created  
Indian reservations and when it added to them, it  
reserved the use of enough water to irrigate the  
irrigable portions of the reserved land. The Indian  
water right is based on the date the reservation  
was set aside for Indian use, either by treaty, act of  
Congress, or by executive order. Problems arise in  
determining which water sources were reserved.  
These problems become more serious as water  
resources are put to full use. A history of court  
decisions has left the Indian people with water  
rights. Today, Indian nations are increasingly  
acting to secure their rights. This means utilizing  
the water in their territories. These rights are be-  
coming increasingly controversial and political as  
the needs of urban centers and industry intensify.  
With historical momentum and contemporary and  
future political realities on a collision course, the  
water battle will be a primary issue. (Ewing-Flor-  
ida)

MEETING

o. 2, p 35-38,

\*Indian res-  
government,  
law, Federal  
Federal reser-  
vations

threatening to  
water rights  
ness of Ameri-  
n rights to use  
real property;  
in the tribes,  
and protected  
ment. It is the  
government, as  
distinction be-  
the tribes have  
control and allo-  
cations. The  
taining to: (1)  
ederal actions  
conding for con-  
ent of Indian  
for land classi-  
ds; (3) amend-  
it; (6) Indian  
vs. tribes; (8)  
al water law  
tion of Indian

ALTERNATIVE REGIMES FOR THE OCEAN,  
S. Brown, N. W. Cornell, L. L. Fabian, and E. B.  
Weiss.  
In: Regimes For The Ocean, Outer Space, and  
Weather, p 19-34, The Brookings Institute, Wash-  
ington, D.C., 1977.

Descriptors: \*Law of the sea, \*Oceans, \*Regime,  
\*International law, Resources development, Natu-  
ral resources, Exploitation, Oil, Natural gas, Ex-  
ploration, International waters.

Recent and prospective developments affecting the  
ocean are severely undercutting the previous mari-  
time order. The old order was based largely on  
principles of open access to and free use of the  
waters beyond the narrow territorial seas. It is now  
generally accepted that the open access regime  
will not and should not continue through the  
1970's. This is the premise of the Third United  
Nations Law of the Sea Conference, which con-  
vened in 1973. The nature of the successor regime  
is still unclear. The basic technological and social  
forces affecting man's perspectives on the ocean  
are discussed. The topics covered include: (1) the  
revolution in marine technology; (2) the rise of  
ecological consciousness; (3) the new economics of  
ocean resources scarcity; (4) the new demands for  
international income redistribution; (5) the new  
ocean politics; (6) open access and free use of the  
oceans; and (7) national and international manage-  
ment of the oceans. Alternative regimes for ocean

RAL RICHES

8, 32, March,

\*International  
United Nations,  
Foreign coun-  
under water,

en Hawaii and  
long and 800  
billions of ore-  
world has recog-

management are discussed at length. (Coffey-Flor-  
ida)  
W80-00377

THE MANAGEMENT FISHERIES,  
S. Brown, N. W. Cornell, L. L. Fabian, and E. B.  
Weiss.  
In: Regimes For The Ocean, Outer Space and  
Weather, p 50-62, The Brookings Institute, Wash-  
ington, D.C. 1977.

Descriptors: \*Law of the sea, \*Fish management,  
\*International law, Fish farming, Fish conserva-  
tion, Fish harvest, Fish migration, Fish popula-  
tions, Fish stocking, International commissions, In-  
ternational waters.

Worldwide, many fish stocks are either already  
overfished or are threatened with depletion. In  
response to this threat, some countries have estab-  
lished regional fishery commissions and have en-  
tered into agreements to follow certain rules for  
stock conservation. These multilateral agreements  
are only minor variants of the basic international  
regime of open access and freedom to fish, which  
means that property rights to a fish are established  
by capture. In other regions of the world, the  
prevailing response to emerging fish scarcities has  
been unilateral extension of national fishing juris-  
dictions. The Law of the Sea Conference is likely  
to endorse wide coastal fishing zones. The exten-  
sion of national control fails to deal with the tran-  
sitional mobility of some fish stocks and the inter-  
dependence of species. An extensive analysis of the  
sources of and possible remedies to the growing  
problem of overfishing is presented. The ineffec-  
tiveness of both the national and multinational  
approaches is demonstrated. More extensive and  
intensive international management is needed.  
(Coffey-Florida)  
W80-00378

OFFSHORE OIL AND GAS EXPLOITATION,  
S. Brown, N. W. Cornell, L. L. Fabian, and E. B.  
Weiss.  
In: Regimes for the Ocean, Outer Space and  
Weather, p 63-72, The Brookings Institute, Wash-  
ington, D.C., 1977.

Descriptors: \*Oil, \*Natural gas, \*Law of the sea,  
\*International law, Federal jurisdiction, Explora-  
tion, Offshore platforms, Oil pollution, Oil reser-  
voirs, Continental shelf, Energy, Political con-  
straints.

The exploration for oil and gas at progressively  
greater depths and offshore distances has been an  
important catalyst to the revision of the traditional  
open access law of the sea. Revisions have been  
mainly in the form of unilateral extensions of na-  
tional jurisdiction by coastal states over all petro-  
leum resources in their adjacent continental  
shelves. As more countries assert such jurisdiction  
the inadequacy of the unilateral approach becomes  
more evident, for many potential hydrocarbon de-  
posits lie in areas claimed by several states. The  
many developing problems created by increased  
international exploitation of the world's ocean de-  
posits of hydrocarbons are examined. Some of the  
issues discussed include: (1) the extent and distribu-  
tion of the ocean's hydrocarbon resources; (2) the  
problems of jurisdiction and allocation; (3) the  
conflicts with other ocean uses; and (4) the require-  
ments of effective management. Effective manage-  
ment requires a combination of efficient exploita-  
tion of resources, minimizing the potential for dan-  
gerous international conflict, and due consideration  
of other user's rights and the condition of the sea.  
(Coffey-Florida)  
W80-00379

AIR AND WATER POLLUTION POLICY,  
Resources for the Future, Inc., Washington, DC.  
Fellow Issues of the Environment Div.  
A. M. Freeman.  
In: Current Issues in U.S. Environmental Policy, p  
12-67, The John Hopkins University Press, Balti-  
more, Maryland, 1978.

Descriptors: \*Clean Air Act, \*Federal Water Pol-  
lution Control Act, \*Water quality standards,

\*Water quality control, Air pollution, Water pollu-  
tion, Legislation, Air environment, Cleaning, Reg-  
ulations, Federal government, Water law.

Between 1970 and 1972, Congress passed two  
major pieces of legislation that established air and  
water pollution control strategies for the 1970's.  
These were the 1970 Clean Air Amendments  
(CAA) and the 1972 Federal Water Pollution Con-  
trol Amendments (FWPCA). They established  
new goals and standards for air and water quality,  
set deadlines for clean-up actions, and created new  
procedures and mechanisms for regulation and en-  
forcement. Those portions of the CAA and  
FWPCA dealing with stationary sources are exam-  
ined. Such an examination might prove helpful in  
assessing recent and proposed changes in our basic  
air and water pollution control laws. No attempt is  
made at a complete evaluation of existing policies  
or at definitive judgment concerning their effec-  
tiveness. Some of the major problems that have  
emerged during efforts to implement the CAA are  
identified and examined from an economic per-  
spective. Some proposed changes in policy are  
suggested. (Coffey-Florida)  
W80-00380

REPORT TO THE CONGRESS ON OCEAN  
POLLUTION OVER FISHING, AND OFF-  
SHORE DEVELOPMENT (OCTOBER 1976  
THROUGH SEPTEMBER 1977).  
Department of Commerce, Washington, DC.  
Annual Report to Congress, National Oceanic and  
Atmosphere Admin., Dept. of Commerce, Novem-  
ber 1978, 49 p, 7 tab, 3 fig.

Descriptors: \*Oceans, \*Marine fisheries, \*Water  
pollution control, Mining, Management, Oil pollu-  
tion, Oil wells, Natural gas, Alaska, Environment,  
Fish populations.

The findings of programs developed in response to  
Section 202, Title II, of the 1972 Marine Protec-  
tion, Research, and Sanctuaries Act are summa-  
rized. Long-term effects research carried out by  
the National Oceanic and Atmospheric Adminis-  
tration (NOAA) in fiscal year 1977 emphasized  
petroleum hydrocarbons, heavy metals, fishery  
stock assessments, ocean mining, and oil and gas  
development on the Alaskan Outer Continental  
Shelf. These investigations provide the data and  
information required to make more definitive eval-  
uations of the effects of human activities on the  
ocean environment. Included are many illustrative  
tables, charts, and maps. There are three chapters:  
(1) Ocean Pollution; (2) Overfishing, and (3) Off-  
shore Development and the Ocean Environment.  
Chapter (1) includes findings on the effect of petro-  
leum hydrocarbons and heavy metals on marine  
organisms. Chapter (2) covers Northwest Atlantic  
fisheries and related federal legislation. Chapter (3)  
discusses ocean mining and the Outer Continental  
Shelf Environmental Assessment Program.  
(Coffey-Florida)  
W80-00381

OBTAINING ACCESS TO SOLAR ENERGY:  
NUISANCE, WATER RIGHTS, AND ZONING  
ADMINISTRATION,  
C. Polis.  
Brooklyn Law Review, Vol. 45, No. 2, p 357-90,  
Winter 1979.

Descriptors: \*Riparian rights, \*Solar radiation,  
\*Prior appropriation, Water law, Water rights, Ra-  
diation, Easements, Zoning, Energy, Resources de-  
velopment.

The energy crisis has intensified legislative interest  
in alternative energy sources and has triggered  
renewed legal interest in the means of obtaining  
access to these sources. Solar energy has been a  
focal point of attention. The use of easement law is  
ineffective as a means of securing solar energy.  
New applications of nuisance law, water rights  
concepts, and zoning administration will guarantee  
access to solar energy. Streams of light may be  
analogized to surface water courses. Rights to  
both attach to the flow and not the corpus. A right  
in water is defined by use rather than by posses-  
sion. Because of the analogous nature of solar

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

energy, the entitlement to solar energy may also be defined in terms of use. The same principles that govern water law can be applied to solar resources. Included are sections on: riparian water rights, and rural solar rights, and prior appropriation water law and urban solar rights. Once the entitlement to solar access is judicially recognized, the issue of who will receive the entitlement must be resolved. Water law may serve as a model for that determination. (Coffey-Florida)  
W80-00382

**SEA CHANGES AND THE AMERICAN REPUBLIC.**  
Georgia Univ., Athens.  
D. Rusk, and M. S. Ball.  
Georgia Journal of International and Comparative Law, Vol. 9, No. 1, p 1-19, 1979.

Descriptors: \*Law of the sea, \*Federal-state water rights conflicts, \*Continental shelf, Coasts, Water law, Federal government, State governments, Federal jurisdiction, Legislation, United Nations, International law.

Major changes in the law of the sea are near. Past treaties have failed to resolve the issues of the breadth of territorial seas and the outer limits of the continental shelf. Changes in the international law of the sea will have a profound effect on the internal arrangements of the United States. Questions will arise concerning the sharing of responsibilities between federal and state governments. These should be considered now rather than later resolved as an impulsive reaction to the changing world situation. While federal and state governments each recognize the legitimate interest of the other in the sea, there has been no ordering of federal-state relation in the marine resources governance. The United States should consider extending its territorial sea from three to twelve miles. Preliminary debate on and implementation of a territorial sea change would provide a context for re-thinking federal-state relations, for development of a comprehensive oceans policy, and for meaningful public participation. (Vloedman-Florida)  
W80-00383

**RE-USE OF FOREIGN WATERS.**  
W. H. Fischer.  
Colorado Lawyer, Vol. 7, No. 4, p 522-35, 1978.

Descriptors: \*Colorado, \*California, \*Water re-use, \*Foreign water, Imported water, Water rights, Water policy, Appropriation, Water law, Water importing, Water users.

As to the relative rights of appropriators of water imported into the South Platte River and the developer of those waters, the Colorado Supreme Court has definitively pronounced that the developer (1) may re-use; (2) may make successive use of; and (3) after use, may make disposition of imported water. A vital question remains: where an importer of water has, after its use, discharged the unconsumed water into the natural streams of the state from which it has been appropriated by other, may the importer thereafter recapture it from the stream. The tendencies of the Colorado and California court rulings indicate that re-use is an attractive, even popular concept. However, the concept of re-use abandonment, or loss of the right to make a re-use or a succession of uses of foreign water, should be rejected in spite of compelling arguments in its favor. (Corey-Florida)  
W80-00384

**PLANNING CONSIDERATIONS FOR PRESERVATION AND USE OF THE NATIONAL SEASHORES.**  
National Park Service, Denver, CO.  
A. H. Robinson.  
Coastal Zone Management Journal, Vol. 5, No. 1/2, p 5-34, 1979. 2 tab, 4 fig.

Descriptors: \*National parks, \*National seashores, \*Planning, \*Preservation, Environmental effects, Parks, Barrier islands, Seashores, Conservation, Waterfowl, Coasts.

The historical development of the 'national seashore' national parks and the evolution of basic planning and management policies applied to these areas are reviewed. Some common planning issues in the national seashores include: (1) zoning problems for natural, historic, development and special-use zones; (2) carrying capacity; (3) transportation and access modes; (4) land ownership and legal jurisdiction over submerged lands, eroding boundaries, fast lands, extended tenancies on private lands, and shared administrations; and (5) traditional resource use problems like sport and commercial fishing, hunting and overland vehicle use. The future of the national seashores and barrier island conservation and development and the future role of federal agencies and private organizations are discussed. Included are 120 references and several tables, charts and maps. (Coffey-Florida)  
W80-00385

**PLANNING FOR ENVIRONMENTAL MANAGEMENT: NEW DIRECTIONS AND INITIATIVES.**  
Research Group, Inc., Atlanta, GA.  
L. F. Dean.  
Coastal Zone Management Journal, Vol. 5, No. 4, p 285-306, 1979. 3 tab.

Descriptors: \*Environmental control, \*Water quality control, \*Water management (Applied), Planning, Programs, Coasts, Water quality, Federal government, Regulation, Water uses, Land use.

Environmental management planning is an emerging professional discipline characterized by a new set of implementation tools. The direction of environmental management planning is identified. Two federally funded programs are reviewed: the Coastal Zone Management Program (CZM) under the United States Commerce Department and the '208' Area-wide Water Quality Management Planning Program ('208') under the federal Environmental Protection Agency. The CZM and '208' plans and programs, expected to receive federal agency approval during 1977-1978, and CZM and '208' legislation form the basis for the comparison. Several tables are included for comparison analysis. Some of the topics covered include: (1) legislative comparison; (2) designation of lead agency for program development; (3) program requirements for land and water use regulation; (4) new program implementation approaches included in the legislation; (5) analysis of methods for program implementation; (6) legal authority; (7) inter agency coordination; and (8) key findings on the future directions for environmental management planning. The implementation methods being used by the two programs have a number of similarities. (Coffey-Florida)  
W80-00386

**COMPENSATING STATES AND THE FEDERAL GOVERNMENT FOR DAMAGES TO NATURAL RESOURCES RESULTING FROM OIL SPILLS.**  
National Advisory Committee on Oceans and Atmosphere, Washington, DC.  
J. S. Mattson.  
Coastal Zone Management Journal, Vol. 5, No. 4, p 307-32, 1979. 2 tab.

Descriptors: \*Replacement costs, \*Clean Water Act, \*Oil spills, Oil pollution, Ecosystems, Compensation, Damages, Oceans, Beaches, Taxes.

An unsatisfactory system of assessing damages from careless management of energy resources is developing. The replacement cost concept satisfies courts but does not reflect the real value of ecosystem damage. Compensation issues are examined in light of existing common law schemes such as nuisance and pending statutory plans such as 'Superfund.' The five types of ecological damage from oil spills are: human food contamination, decrease of fisheries resources or damage to wildlife, loss of esthetic values by oiling of beaches, modification of marine ecosystems diversity and productivity, and habitat modification affecting recolonization. Superfund, proposed by section 311 of the Clean Water Act, works to eliminate the inequities of oil pollution costs. It involves a \$200 million, self-

replenishing compensation fund supported by a three-cent per barrel tax on crude oil. Superfund's basic premise is to spread the cost of oil spills over the entire energy using population, while leaving the individual spillers at a disadvantage to the extent that they cannot pass on the costs. (Corey-Florida)  
W80-00387

**GEOTHERMAL ENERGY: PROBLEMS AND SHORTCOMINGS OF CLASSIFICATION OF A UNIQUE RESOURCE-A LOOK AT PROBLEMS WITH WATER LAW, WITH PARTICULAR EMPHASIS ON NEW MEXICO.**  
R. M. Silver, and S. P. Comeau.  
Natural Resources Journal, Vol. 19, No. 2, p 445-59, April 1979.

Descriptors: \*New Mexico, \*Geothermal studies, \*Energy, Mineral industry, Heated water, State jurisdiction, Natural resources, Water rights, Classification, Legal aspects.

Geothermal energy, a unique natural resource difficult to legally classify as mineral or water, creates complex legal issues. The essence of the resource's value is its pure heat energy. The resource is literally the earth's natural heat but statutory definitions include many by-products. The classification of geothermal resources will have far-reaching effects on the legal treatment of the resource and on its economic potential for development. States with the most lucid, explicit, and comprehensive laws in the area will benefit most from the resource, encouraging development of a relatively efficient and environmentally sound form of energy production. Even after some type of classification is attempted, two questions remain unclear: ownership by the mineral users versus surface estate holders and jurisdiction over the resource. Under New Mexico's geothermal laws, whatever the final classification of the resource, any water involved must be treated separately from the mineral. This would allow several approaches of dealing with geothermal water, depending on whether water in a geothermal formation is depletable and non-tributary or connected to a state's natural tributary water system. (Corey-Florida)  
W80-00388

**CONTROLS AND REMEDIES FOR GROUND WATER - CAUSED LAND SUBSIDENCE.**  
J. Teutsch.  
Houston Law Review, Vol. 16, No. 2, p 283-331, 1979.

Descriptors: \*Texas, \*Subsidence, \*Ground water, \*Water management (Applied), Judicial decisions, Common law, Absolute ownership doctrine, Underground water conservation, Regional water management, Administrative agencies, Legislation.

Ground water is a valuable resource in the Houston-Galveston region of Texas, but unrestrained withdrawal has caused land surface subsidence. Tort actions and administrative regulation are legal tools for solving the problem. Two legal aspects are reviewed: the general common law on ground water and the 'absolute ownership' rule of the Texas Supreme Court which is that the owner of surface lands owns all water flowing beneath the surface. The Texas court has recently modified the rule to allow damages to one injured by subsidence from ground water pumpage negligently conducted by a neighboring property owner. Management of the subsidence problem is better suited to agency regulations. The legislatively established Harris-Galveston Coastal Subsidence District has had some success in dealing with the problem. The District's authority is too geographically narrow for two reasons: it covers only two counties and not the entire affected area and substantively no authority exists for it to provide surface water alternatives to ground water withdrawals. (MacGregor-Florida)  
W80-00389

**THE LAW OF THE SEA: A REJOINDER TO RICHARD G. DARMAN,**  
Pittsburg Univ., PA.

Data Acquisition—Group 7B

D. S. Cheever.  
Foreign Affairs, Vol. 56, No. 3, p 660-65, April 1978.

Descriptors: \*International law, \*International waters, \*Water rights, Water policy, \*United Nations, Mining treaties, Natural resources, Legal aspects, Foreign countries, Beds under water.

In January 1978, Richard J. Darman advocated rethinking United States interests in achieving a comprehensive agreement at the Law of the Sea Conference. Darman's argument relied heavily on five critical judgments concerning the present state of the Informal Composite Negotiating Text. Each of these judgments is erroneous. There is a substantial chance that the Conference will not produce a draft acceptable to the U.S. delegation. The best U.S. fallback position in that event would be to pursue the possibility of wide acceptance of a partial treaty. The treaty might embody agreed general principles concerning the seabed, without addressing the difficult problems of control and governance. These would be left to a future Conference, with the corollary that the U.S. would slow down its effort to embark on deep seabed mining operations. The partial treaty as contrasted with the proposal mini-treaty would build on areas of agreement rather than disagreement. It would bypass the Conferences principle roadblock, the International Seabed Authority. A mini-treaty, dealing solely with access rights to seabed minerals, would jeopardize a wide agreement on an ocean regime that has already been achieved. (Ewing-Florida)  
W80-00390

## 6F. Nonstructural Alternatives

LOCAL GOVERNMENT RESPONSE TO STATE-MANDATED LAND USE LAWS, Oregon State Univ. Corvallis.  
For primary bibliographic entry see Field 6E.  
W80-00369

## 6G. Ecologic Impact Of Water Development

STREAM CHANNEL MODIFICATION IN HAWAII. PART A: STATEWIDE INVENTORY OF STREAMS: HABITAT FACTORS AND ASSOCIATED BIOTA, Hawaii Cooperative Fishery Research Unit, Honolulu.  
A. S. Timbol, and J. A. Maciolek.  
U.S. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-78/16. April, 1978. 157 p. 16 fig, 16 tab, 40 ref, 3 append.

Descriptors: \*Hawaii, \*Census, \*Stream improvement, \*Ecological effects, \*Aquatic habitat, Streams, Channel improvement, Stream stabilization, Perennial streams, Fish, Biomass.

There are at least 366 perennial streams in the five largest islands of Hawaii. Fifteen percent of these streams have been altered. Six types of channel alteration have been identified: lined channel, channel realignment and riparian clearance, elevated culvert, revetment, filled-in channel, and extended culvert. A total of 151 km of these modifications has been identified. On the basis of other human disturbances, only 14% of Hawaiian streams may be physically pristine, and none of these is on Oahu, the most populous island in the state. There are apparently no longer any biologically pristine streams, since at least one exotic species was found in all streams sampled. Only 27% are of high ecological quality (pristine-preservation use), and none of these high ecological quality streams is on Oahu. Both in numbers and biomass, native fish and decapod crustacean species are dominant in most altered streams. Water is exported from 53% of all perennial Hawaiian streams. (See also W80-00004) (Steiner-Mass)  
W80-00003

STREAM CHANNEL MODIFICATION IN HAWAII. PART B: EFFECT OF CHANNELIZA-

TION ON THE DISTRIBUTION AND ABUNDANCE OF FAUNA IN SELECTED STREAMS, Hawaii Cooperative Fishery Research Unit, Honolulu.

S. E. Norton, A. S. Timbol, and J. D. Parrish.  
U.S. Fish and Wildlife Service, Office of Biological Services, Report FWS/OBS-78/17. May, 1978. 47 p, 6 fig, 11 tab, 30 ref, 1 append.

Descriptors: \*Hawaii, \*Stream improvement, \*Ecological effects, \*Aquatic habitat, Streams, Channel improvement, Stream stabilization, Perennial streams, Fish, Water quality, Water temperature, Hydrogen ion concentration, Conductivity.

Three physiochemical features (water temperature, pH, conductivity) were measured to obtain a general idea of habitat factors in altered and unaltered streams. The aquatic community structure was evaluated for each stream and interstream comparisons were made. The altered streams were found to have higher mean physiochemical values coupled with wider ranges than unaltered streams. Channel sections with artificial (concrete) bottom exhibited higher values compared with natural bottom channels. Exotic fish species were predominant in altered streams while both exotic fish and native crustaceans were predominant in unaltered streams. Native fishes appeared to be especially reduced in heavily channelized streams. Altered channels with artificial bottoms appear to serve as nurseries for the exotic poeciliids, *Poecilia mexicana* and *Poecilia reticulata*. Species diversity was lower in these artificial bottom channels. (See also W80-00003) (Steiner-Mass)  
W80-00004

RELATIONSHIPS BETWEEN RESPIRATORY CANCER AND WETLANDS RESIDENCY IN LOUISIANA, Louisiana State Univ. Medical Center, New Orleans. Dept. of Preventive Medicine.  
A. W. Voors, W. D. Johnson, S. H. Steel, and H. Rothschild.  
Archives of Environmental Health, Vol. 33, No. 3, p 124-129, May-June, 1978. 5 fig, 2 tab, 31 ref.

Descriptors: \*Wetlands, \*Louisiana, \*Public health, \*Mortality, Diseases, Hazards, Land use.

Multiple regression analysis was applied to cancer mortalities in the State of Louisiana which were adjusted for age and urban residency, and specific for race, sex, amount of standing water in the parish of residency, and cancer site. The smoking related cancer mortality for men showed not only an association with residence in wetlands but also was higher in the Louisiana wetlands than in the remainder of the United States. (Howard-Mass)  
W80-00015

THE FLUVIAL SYSTEM: SELECTED OBSERVATIONS, California Univ., Santa Barbara. Dept. of Geological Sciences.

For primary bibliographic entry see Field 2E.  
W80-00019

DATA COMPILATION OF PERIPHYTON COLONIZED ON ARTIFICIAL SUBSTRATES PLACED IN THE SACRAMENTO AND FEATHER RIVERS, CALIFORNIA, 1975, Geological Survey, Menlo Park, CA. Water Resources Div.  
L. J. Britton, and R. F. Ferreira.  
Available from Branch of Distribution, USGS Box 25425, Fed. Ctr. Denver, CO. 80225. Microfiche \$3.50, Paper copy \$4.50. Geological survey open file report 79-696, May 1979. 33 p, 2 fig, 3 tab, 7 ref.

Descriptors: \*Periphyton, \*Growth stages, \*Artificial substrates, \*Water quality, \*Environmental effects, Sediment transport, Suspension, Streams, Phytoplankton, Biomass, Data collections, California, \*Sacramento River, \*Feather River(CA).

Periphyton was collected from artificial substrates placed in the Sacramento and Feather rivers, California, and analyzed to determine the rate of colo-

nization and succession of periphyton types with time. Samples for determination of water-quality characteristics, especially suspended-sediment concentrations, that might have a direct effect on the growth of periphyton were collected during each station visit. This paper describes the methods of data collection and presents qualitative and quantitative findings of periphyton collected during two colonization periods (August 5-September 5, 1975, and November 28-December 29, 1975) and associated water-quality data. (Woodard-USGS)  
W80-00223

WEED CONTROL METHODS FOR RIVER BASIN MANAGEMENT, Corps of Engineers, Washington, DC.  
For primary bibliographic entry see Field 2L.  
W80-00223

INTERNATIONAL ENVIRONMENTAL IMPLICATIONS OF SOVIET DEVELOPMENT OF THE VOLGA RIVER, Western Michigan Univ., Kalamazoo.  
For primary bibliographic entry see Field 6E.  
W80-00368

## 7. RESOURCES DATA

### 7A. Network Design

PYRITE: ITS RAPID FORMATION IN A SALT MARSH AND ITS IMPORTANCE TO ECOSYSTEM METABOLISM, Woods Hole Oceanographic Institution, MA. Joint Program in Biological Oceanography.  
For primary bibliographic entry see Field 2K.  
W80-00311

NITROGEN DYNAMICS AND MODELING IN A FRESHWATER WETLAND, Michigan Univ., Ann Arbor.  
For primary bibliographic entry see Field 2K.  
W80-00327

### 7B. Data Acquisition

REMOTE SENSING AS A TOOL FOR STUDYING THE ECOLOGY OF HALOPHYTES, Georgia Univ., Sapelo Island. Marine Inst. J. L. Gallagher.  
In: Ecology of Halophytes, Reimold, R. J. and Queen, W. H. (eds.). Academic Press, Inc., New York, p 511-523, 1974. 5 fig, 1 tab, 23 ref.

Descriptors: \*Remote sensing, \*Halophytes, \*Ecology, Wetlands, Marshes, Mapping, Salt marshes, Photogrammetry, Marsh plants, Aerial photography, Distribution patterns.

The most widespread use of remote sensing techniques to date has been in mapping the distribution of various halophyte stands. Recently ecologists are beginning to seek answers to questions of production, the detection of nutrient changes and the sequence of inundation of the various stands of intertidal halophytes. Detection and analyzing techniques, as well as interest, are developing rapidly and new applications of remote sensing to answering questions of halophyte ecology will soon be realized. (Steiner-Mass)  
W80-00037

GUIDELINES FOR THE USE OF STRUCTURAL VERSUS REGRESSION ANALYSIS IN GEOMORPHIC STUDIES, Geological Survey, Lawrence, KS. Water Resources Div.  
W. R. Osterkamp, J. M. McNellis, and P. R. Jordan.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-298 360. Price codes: A06 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 78-135, November 1978. 22 p, 6 fig, 2 tab, 10 ref.

## Field 7—RESOURCES DATA

### Group 7B—Data Acquisition

Descriptors: \*Geomorphology, \*Structural analysis, \*Regression analysis, \*Evaluation, Simulation analysis, Methodology, Equations, Alluvial channels, Streamflow, Gradation, Curve-fitting techniques.

Regression analysis is a useful curve-fitting technique, but it often is misapplied to geomorphic data sets. When error components can be identified for both variables, the statistical technique of structural analysis is preferred. If regression results are available, conversion to a structural analysis can be made either manually or by computer. Use of computer-generated data sets permits the construction of curves relating variation between regression and structural analyses to the range of data of the independent variable. The data have randomly imposed error components of specified standard deviation and a slope of the linear relation that simulates gradient-discharge relations of natural alluvial streams. The empirically developed curves can be used to determine the need for structural analysis of real geomorphic data sets. (Woodard-USGS)

W80-00224

#### AN INDUCTIVE-COUPLED PLASMA ATOMIC-EMISSION SPECTROMETRIC METHOD FOR ROUTINE WATER QUALITY TESTING

Geological Survey, Denver, CO. Water Resources Div. J. R. Garbarino, and H. E. Taylor. Applied Spectroscopy, Vol. 33, No. 3, p 220-225, 1979. 11 fig, 7 tab, 28 ref.

Descriptors: \*Water analysis, \*Chemical analysis, \*Analytical techniques, \*Spectrometers, \*Metals, Trace elements, Water quality, \*Emission spectrometry, \*Inductively coupled plasma.

Induction-coupled plasma atomic-emission spectrometry offers an ideal method for simultaneous multielement analysis of natural water samples. The Water Resources Division of the U.S. Geological Survey currently employs this technique for quantitative analysis of 17 major and trace constituents. These include analysis of Ba, Be, Cd, Co, Cu, Fe, Pb, Li, Mn, Sr, Mo, V, Zn, Ca, Mg, Na, and SiO<sub>2</sub> in a routine production mode, in which an excess of 1,000 determinations can be made in a normal working day. Comparability studies with conventional single-element methods of analysis, such as atomic absorption spectrometry and colorimetric techniques, show essentially equivalent accuracy and precision, frequently at much higher sensitivity. (Woodard-USGS)

W80-00229

#### FORMULATION AND TESTING OF A NEW WATER QUALITY INDEX

Toronto Univ. (Ontario). Dept. of Civil Engineering. B. Ibbotson, and B. J. Adams. In: Water Pollution Research in Canada 1977. Proc. of Twelfth Canadian Symp. on Water Poll. Research, Univ. Toronto, Feb. 1977, and Eastern Div. Symp., Concordia Univ. Montreal, Dec. 1976, p 101-119. 2 fig, 1 tab, 2 eq, 17 ref.

Descriptors: \*Water quality, \*Indices, \*Methodology, \*Environmental control, Evaluation, Water supply, Phosphorus, Recreation, Matrix approach, Parameters, Raw water, Equations, Measurement, Data collection, Information display.

The need to protect our environment has promoted the development of new ways to communicate environmental information to policy makers and the general public. Presented is a new formulation which translates water quality parameter values into simple numerical results which can then be summed to give water quality index scores. The mechanism uses the matrix format to organize the display results with water quality parameters on one axis and common water activities on the other. The mechanism's task is then to assess the suitability of each parameter to each activity, and subsequently to render the results into simple scores. The index can be applied to any situation in which water quality is a consideration. Its applicability

lies in its offering to the perspective user the opportunity to calibrate the index to the needs of a specific situation. The procedure offers a systematic approach that is highly flexible and that generates results which are easily understood. The principal reasons for developing this index mechanism are to enable presentation of a simplified measure of water quality and to augment expert assessment of raw water quality data, not to supplant this important aspect of water quality management. (Bell-Graf-Cornell)

W80-00304

#### SAMPLING MACRO-ORGANIC MATTER PROFILES IN SALT MARSH PLANT ROOT ZONES

Georgia Univ., Sapelo Island. Marine Inst. For primary bibliographic entry see Field 21. W80-00309

#### RAINFALL MEASUREMENT BY RADAR

British Meteorological Office, Bracknell (England). C. G. Collier.

Paper 1. Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 31 p, 12 fig, 4 tab, 13 ref, 1 append.

Descriptors: \*Remote sensing, \*Radar, \*Rainfall, Precipitation (Atmospheric), Instrumentation, Equipment, Measurement, On-site investigations, Rain gages, Networks, Watersheds (Basins), Data processing, Analytical techniques, Meteorology, \*England.

During the last three years a weather radar has been used to measure surface rainfall over hilly terrain in North Wales. Up to autumn 1973, the radar in use was a Plessey Type 43 S-band with a wavelength of 10 cm; thereafter the radar was converted to C-band by changing the wavelength to 5.6 cm. The change of wavelength was carried out because it was an economical means of reducing the beam width. This was required, to reduce the number of occasions when the melting layer is intersected by the radar, which decreases the measurement accuracy, to reduce the amount of permanent echo, and to reduce the effect of low level changes in rainfall on the accuracy of estimates of rainfall at the surface. A comparison between the accuracy of surface rainfall measurements over sub-catchments using the S- and C-band radars revealed no difference in the accuracies other than that directly attributable to different meteorological conditions during the two periods of operation. A comparison between a rain gage calibrated radar system and rain gage networks of various densities revealed that when the melting layer is above the top of the radar beam, the radar measurements for one-hour periods calibrated with the readings from two rain gages at two different sites within the area of 1,000 sq km, had a mean error over sub-catchments of 18%. This accuracy may be achieved with a rain gage network of 8 rain gages per 1,000 sq km in widespread rain, and about 50 rain gages per 1,000 sq km in showery weather. (Sims-ISWS)

W80-00329

#### A SYSTEM FOR REAL-TIME PROCESSING TRANSMISSION AND DISPLAY OF RADAR-DERIVED RAINFALL DATA

Royal Radar Establishment, Malvern (England). B. C. Taylor. Paper 2. Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 15 p, 8 fig, 5 ref.

Descriptors: \*Radar, \*Rainfall, \*Remote sensing, Data processing, Communication, Computers, Equipment, Instrumentation, Precipitation (Atmospheric), Rainfall intensity, Analytical techniques, Meteorology, \*England, Data display.

A computer-based system was described which at low cost can make available in real time and to a large number of users digitized data on precipitation intensity (mm/hr) or amount (mm) with a high

resolution in space and time. The data can be presented to meteorological, hydrological, and other users as a color-coded image on a stand-alone television terminal, or on a conventional teletype, or it can be fed directly to a user computer for further manipulation. All communications between radar site and users are over standard telephone circuits. Systems have been installed at three research radar stations, and television terminals remotely displaying the radar-derived rainfall patterns have been operating in the Central Forecast Office, Bracknell, and the Welsh National Water Development Authority Office, Bala (North Wales), since February 1975. With the recent installation of a PDP11 computer at Bala, that location is now receiving sub-catchment rainfall totals in addition to the overview data for display. The new system, with the variety of outputs it makes available, should encourage a much wider adoption of weather radar for operational uses in meteorology, hydrology, and other fields (e.g., aviation, civil engineering) which can benefit from real-time (and eventually forecast) rainfall data. (Sims-ISWS)

W80-00330

#### DESIGN OF THE DEE TELEMETRY SYSTEM WITH COMPUTER ACQUISITION OF DATA

Water Resources Board, Reading (England). A. A. Rowse, and B. H. Roberts. Paper 3. Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 21 p, 5 fig, 3 ref, 1 append.

Descriptors: \*Rain gages, \*Radar, \*Water levels, \*Data collections, Telemetry, Data transmission, Runoff, Lakes, Streamflow, Equipment, Instrumentation, Design, Rainfall, Precipitation (Atmospheric), Weather data, Meteorology, \*England, \*River Dee, Data display.

The upstream portion of the River Dee catchment in North Wales contains a regulating reservoir, Llyn Celyn (storage capacity 80 million cu m) and a natural lake, Llyn Tegid at Bala, adapted for flood control purposes (storage capacity 18 million cu m). A second regulating reservoir, Brenig (initial storage capacity 60 million cu m) is under construction. In addition, there is the Alwen direct supply reservoir. The river basin covers some 1,800 sq km. Research on the Dee is being carried out to ascertain the possible benefits of using a real-time mathematical model for the control and operation of the multi-purpose reservoir system. The input data it requires are gathered by telemetry; this paper described the design philosophy adopted and the equipment maintenance and discussed the reliability achieved in this difficult terrain. The computer acquisition of data was also described. The computer system at the Control Centre comprises a PDP 11/40 processor with a 2.4 megabyte cartridge disc and 32K of core store. It is linked to a variety of peripherals such as the outstation control unit, the mimic panel, the color VDU TV monitor system, etc. The software has been designed to meet the specifications of the System in such a way that it can be understood and modified by personnel who are not primarily software specialists. (Sims-ISWS)

W80-00331

#### INSTALLATION AND OPERATION OF THE DEE TELEMETRY SYSTEM

Welsh National Water Development Authority, Cardiff (Wales). D. J. Roberts, and P. Mainwaring. Paper 4. Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 7 p.

Descriptors: \*Telemetry, \*Rainfall, \*Water levels, \*Instrumentation, Equipment, Radar, Rain gages, Streamflow, Lakes, Storage, Reservoirs, Reservoir operation, Precipitation (Atmospheric), Weather data, Meteorology, Hydrology, \*England, \*Wales, \*River Dee.

The Dee telemetry system has been in operation for approximately four years, and it has been possible

## Evaluation, Processing and Publication—Group 7C

ble to assess its limitations and also to satisfy the requirements of the various other participants in the Dee Research Programme. The installation of the system was described, and the solutions of problems incurred were reported. Operational problems were also reported. (Sims-ISWS) W80-00332

**CAPITAL AND OPERATING COSTS OF THE EXISTING DEE RADAR, TELEMETRY AND FLOW FORECASTING PROJECT.**  
Water Resources Board, Reading (England).  
R. B. Bussell.  
Paper 5, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 7 p.

Descriptors: \*Costs, \*Radar, \*Telemetry, \*Rain gages, Rainfall, Precipitation (Atmospheric), Lakes, Reservoirs, Water levels, Flow, Rivers, Equipment, Instrumentation, Data collections, Remote sensing, Networks, Meteorological data, Meteorology, Hydrology, \*England, \*Wales, \*River Dee.

In this paper were given the major costs of equipment and some services which have been used from time to time throughout the Dee Projects, together with an indication of the probable cost of setting up a new rainfall radar station. No costs were given in respect of the time of research staff engaged upon the project. It must be appreciated that due to the accounting methods used and the many authorities and bodies which have been involved and the consequences of reorganization and staff changes since the beginning of the Project, many of the figures are of a rounded budget nature. Appropriate brief descriptions of the chronological order of events were given as necessary. For this reason, the various component parts were first dealt with separately and then combined in the summary. All costs shown, unless otherwise stated, have been rounded up to July 1975 values. During the passage of the works, various small items of capital cost have been incurred, e.g., mobile radios for transport, cleaning equipment, photocopiers, supplies of magnetic tape, etc. No figures were given for such items. No attempt was made to allow for the recoverable current value of capital equipment held. (Sims-ISWS) W80-00333

**RAINFALL FORECASTS IN THE UNITED KINGDOM USING RADAR DATA.**  
British Meteorological Office, Bracknell (England).  
For primary bibliographic entry see Field 2B. W80-00336

**OPERATIONAL USE OF DIGITAL RADAR IN RAINFALL MEASUREMENT AND PREDICTION.**  
National Weather Service, Silver Spring, MD. Office of Hydrology.  
D. R. Greene.  
Paper 9, Weather Radar and Water Management, Water Research Centre, Marlow (England), and Royal Radar Establishment, Malvern (England), 1976. 15 p, 7 fig, 7 ref.

Descriptors: \*Radar, \*Rainfall, \*Data processing, Remote sensing, Analytical techniques, Equipment, Computers, Precipitation (Atmospheric), Flash floods, Measurement, Forecasting, Data transmission, Meteorology, Engineering, \*D/RADEX.

This paper presented a preview and theoretical basis for the operational hydrologic program planned for the Pittsburgh D/RADEX site. Its primary aim was the measurement and prediction of rainfall for flash-flood monitoring. It should be noted that D/RADEX is in a transitional period from experimental to operational. Procurement and implementation of the operational system, RADAP (RADAR DATA PROCESSOR) for which the Pittsburgh D/RADEX is a prototype, will begin within the next 2 years. Current planning within the NWS calls for implementation of RADAP at 71 sites during the next 5 years. (Sims-ISWS)

W80-00337

**A TELEMETRY SYSTEM WORKING THROUGH THE PUBLIC TELEPHONE NETWORK.**  
Louvain Univ. (Belgium).  
For primary bibliographic entry see Field 2E. W80-00339

## 7C. Evaluation, Processing and Publication

**WATER RESOURCES DATA FOR NEBRASKA, WATER YEAR 1978.**  
Geological Survey, Lincoln, NE. Water Resources Div.  
Geological Survey Water-Data Report NE-78-1, May 1979. 514 p, 5 fig, 3 tab.

Descriptors: \*Nebraska, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Nebraska consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 155 gaging stations; stage and contents for 10 lakes and reservoirs; water quality for 55 gaging stations, 17 ungaged stations, 36 partial-record flow stations, and 241 wells; and water levels for 65 observation wells. Also included are 112 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Nebraska. (Woodard-USGS) W80-00234

**WATER RESOURCES DATA FOR ALABAMA, WATER YEAR 1978.**  
Geological Survey, University, AL. Water Resources Div.  
Geological Survey Water-Data Report AL-78-1, March 1979. 568 p, 7 fig, append.

Descriptors: \*Alabama, \*Hydrologic data, \*Surface waters, \*Groundwater, \*Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Water wells, Water levels, Data collections, Sites.

Water resources data for the 1978 water year for Alabama consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 95 gaging stations, stage only for 16 gaging stations, stage and contents for 12 lakes and reservoirs, water quality for 64 gaging stations and water levels for 59 observation wells. Also included are 23 crest-stage partial-record stations, 11 flood hydrograph partial-record stations, and 24 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Alabama. (Woodard-USGS) W80-00235

**UNITED STATES GEOLOGICAL SURVEY YEARBOOK, FISCAL YEAR 1978.**  
Geological Survey, Reston, VA. Water Resources Div.  
Available from Supt. of Documents, GPO, Washington, DC 20402, Price, \$5.50. 1979. 208 p.

Descriptors: \*Reviews, \*Annual, \*Projects, \*Data collections, \*Natural resources, Water resources, Water quality, Energy, Mapping, Geological surveys, Volcanoes, Landslides, Indian reservations, Mineralogy, Land management, Oil industry, Programs, Administration, Cost allocation, Budgeting, \*US Geological Survey.

This Yearbook summarizes the progress made by the United States Geological Survey during fiscal year 1978 in its mandated role to identify the Nation's land, water, energy, and mineral resources; to classify Federally owned mineral lands and waterpower sites; to regulate the exploration and development of energy and mineral resources on Federal and Indian lands; and to explore and appraise the petroleum potential of the National Petroleum Reserve in Alaska. As a report to Congress and the public, it falls logically into five parts: (1) The Year in Review; a look at the major issues and events which affected Survey programs, and some performance highlights; (2) Perspectives; a series of concise earth-science essays which address national issues; (3) Missions, Organization, and Budget; a description of the Geological Survey's major duties and assignments and of the organizational and fiscal structures that support its missions; (4) A description of the activities and accomplishments of each of the operating Divisions and Offices; and (5) Statistical Data; tabular summaries which document program trends, workloads, and significant 1978 accomplishments. (Woodard-USGS) W80-00236

**MAPS SHOWING GROUND-WATER CONDITIONS IN THE LOWER SANTA CRUZ AREA, PINAL, PIMA, AND MARICOPA COUNTIES, ARIZONA—1977.**  
Geological Survey, Tucson, AZ. Water Resources Div.  
A. D. Konieczki, and C. S. English.  
Geological Survey Water-Resources Investigations 79-56 (open-file report), March 1979. 4 sheets, 12 ref.

Descriptors: \*Maps, \*Groundwater, \*Irrigation wells, \*Water levels, \*Water quality, Aquifer characteristics, Withdrawal, Water yield, Drawdown, Land use, Arizona, \*Lower Santa Cruz area (AZ), Pinal County, Pima County, Maricopa County.

The lower Santa Cruz area includes about 5,400 square miles in south-central Arizona and is the second largest agricultural area in the State. The area depends mainly on ground water for irrigation, and in 1976 about 966,000 acre-feet of ground water was pumped from the area. As a result of the large-scale long-term withdrawal of ground water, water levels have declined, and the direction of ground-water flow has changed. Since 1923, declines of nearly 500 feet have occurred near Stanfield. Information shown on the maps (scale 1:125,000) includes depth to water, altitude of the water level, specific conductance, fluoride concentration, change in water level (1923-77), and land use. Hydrographs of the water level in selected wells and a table of historical pumpage also are included. (Woodard-USGS) W80-00239

**WATER RESOURCES OF THE ZUMBRO RIVER WATERSHED, SOUTHEASTERN MINNESOTA.**  
Geological Survey, St. Paul, MN. Water Resources Div.  
H. W. Anderson, Jr., D. F. Farrell, W. L. Broussard, and M. F. Hult.  
Available from Branch of Distribution, USGS Box 25286, Fed. Cir. Denver, CO 80225 price \$4.25. Geological Survey Hydrologic Investigations Atlas HA-543, 1975. 3 sheets, 8 ref.

Descriptors: \*Water resources, \*Surface waters, \*Groundwater, \*Water quality, \*Hydrologic budget, Water availability, River basins, Water utilization, Domestic water, Municipal water, Irrigation, Livestock, Industrial water, Streamflow, Flow rates, Aquifer characteristics, Water yield, Maps, Hydrographs, Curves, Hydrologic data, Water types, Water analysis, \*Zumbro River basin (MN), Southeastern Minnesota.

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

The Zumbro River drains 1,428 square miles and falls from about 1,300 feet altitude in its headwaters to 665 feet at its mouth. The remaining 248 square miles included in the watershed is drained by small creeks flowing directly into the Mississippi River. Distribution of water use is about as follows: domestic, 50 percent; farm (for irrigation and livestock), 18 percent; and industrial, 32 percent. Total usage, in water-budget terms, is 0.24 inch over the entire watershed, or less than 1 percent of inflow (average annual precipitation). Total quantity of water, thus, is of lesser concern than local availability and quality of water. The dominant ions (calcium, magnesium, and bicarbonate) and dissolved solids are reduced by dilution during periods of high water discharge in the Zumbro River at Zumbro Falls. Similarly, in the South Fork Zumbro River near Rochester, dominant ions, dissolved solids, and those ions that are increased by waste disposal (sodium, chloride, and nitrates) are all reduced by dilution at high water discharge. For the Zumbro River the smallest monthly range and the most uniform daily mean discharge usually occurs in January, whereas the greatest range usually occurs in March. The lowest flows usually occur in the winter and the highest during the spring ice breakup. The lowest observed flow, 47 cfs, occurred on February 18, 1961 and the highest, 23,600 cfs, occurred on March 29, 1962. Seventeen of 22 municipalities obtain at least part of their water supply from the Prairie du Chien-Jordan aquifer. Although only one town uses the Galena aquifer, a large number of private domestic wells are completed in it in the western part of the watershed. (Woodard-USGS)  
W80-00240

## 8. ENGINEERING WORKS

### 8A. Structures

**SOIL INVESTIGATIONS: RICHELIEU DAM PROJECT, ST. JOHN'S SHOAL, ST. JOHN, ST. JOHN'S COUNTY, QUEBEC.**  
Mon-Ter-Val, Inc., Montreal (Quebec).  
For primary bibliographic entry see Field 8D.  
W80-00042

**THE COMPARTMENTED RESERVOIR: EFFICIENT WATER STORAGE IN FLAT TERRAIN AREAS OF ARIZONA,**  
Arizona Water Resources Research Center, Tucson.  
C. B. Cluff.

In: Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 1978 Meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, Vol. 8, April 14-15, 1978, Flagstaff, Arizona, p 65-72, 5 fig, 5 ref.

**Descriptors:** \*Reservoir storage, \*Reservoir operation, \*Reservoir design, \*Model studies, \*Water storage, Water management (Applied), Water yield improvement, Computer models, Hydrologic data, Design criteria, Hydrologic budget, Evaporation control, Depth-area curves, Pumped storage, Arizona.

A compartmented reservoir system to increase the efficiency of water storage in flat terrain, high evaporation areas in Arizona and other arid regions is described. Based upon the principle that evaporation loss can be controlled by a reduction in the surface area to depth ratio, the system attempts to concentrate water by pumping it from one compartment to another. A computer model has been developed to study the parameters involved in the system including the volume, area, depth, slope of the embankment around each compartment and their relationship to each other; and to facilitate the selection of optimal design configuration. These parameters interface with the parameters describing the rainfall and hydrologic characteristics of the watershed. A selected number of existing and new reservoir sites in Arizona are presently being studied to provide additional examples of the improvement in efficiency available through use of compartmented reservoir. (Tickes-Arizona)

W80-00277

### 8B. Hydraulics

**VELOCITY PROFILES AND MINIMUM STREAM POWER.**  
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2E.  
W80-00077

**BOUNDARY ELEMENT METHOD FOR FLUID FLOW.**  
Southampton Univ. (England). Dept. of Civil Engineering.  
C. A. Brebbia, and L. C. Wrobel.  
Advances in Water Resources, Vol. 2, No. 2, p 83-89, June 1979. 10 fig, 1 tab, 8 ref.

**Descriptors:** \*Boundary processes, \*Fluid mechanics, \*Analytical techniques, Methodology, Mathematical models, Heat flow, Seepage, Dams, Circulation, Water circulation, Winds, Groundwater, Groundwater movement, Theoretical analysis, \*Boundary element method.

The boundary element method was applied to some fluid flow problems. The methodology was presented in matrix form, starting with a simple time independent potential problem with steady state boundary conditions including free surface. A formulation of time dependent problems, which implies a fundamental solution depending on time as well as the spatial coordinates, was presented. (Sims-ISWS)  
W80-00083

**INTERFACIAL STABILITY IN CHANNEL FLOW.**  
Vanderbilt Univ., Nashville, TN. Dept. of Environmental and Water Resources.  
For primary bibliographic entry see Field 2E.  
W80-00297

### 8D. Soil Mechanics

**SOIL INVESTIGATIONS: RICHELIEU DAM PROJECT, ST. JOHN'S SHOAL, ST. JOHN, ST. JOHN'S COUNTY, QUEBEC.**  
Mon-Ter-Val, Inc., Montreal (Quebec).  
December, 1973. 29 p, 5 append.

**Descriptors:** \*Dams, \*Soils, \*Physical properties, \*Hydraulic structures, Bearing strength, Excavation, Sheet piling, Cofferdams, Caissons, Structures.

Methods used in the investigation are discussed. Bored materials indicated that the overburden consists of till with a small percentage or fraction of residual soils in contact with the parent rock; bored bedrock was entirely Utica shale. Comments and recommendations are made concerning the bearing capacity of till and bedrock excavation procedures. (Stihler-Mass)  
W80-00042

### 8E. Rock Mechanics and Geology

**SOIL INVESTIGATIONS: RICHELIEU DAM PROJECT, ST. JOHN'S SHOAL, ST. JOHN, ST. JOHN'S COUNTY, QUEBEC.**  
Mon-Ter-Val, Inc., Montreal (Quebec).  
For primary bibliographic entry see Field 8D.  
W80-00042

### 8G. Materials

**PHYSICAL AND ENGINEERING PROPERTIES OF HAZARDOUS INDUSTRIAL WASTES AND SLUDGES.**  
Army Engineer Waterways Experiment Station,

Vicksburg, MS. Environmental Effects Lab.

M. J. Bartos, and M. R. Palermo.  
Available from the National Technical Information Service, Springfield, VA 22161 as PB-272 266. Price codes: A05 in paper copy, A01 in microfiche. Report EPA-600/2-77-139, 1977. 88 p, 37 fig, 15 tab, 9 ref.

**Descriptors:** \*Sludge treatment, \*Industrial wastes, \*Electric power industry, \*Coals, \*Physical properties, Chemical reactions, Durability, Compaction, Compressive strength, Strength of materials, Landfills, Embankments, Engineering structures, Ultimate disposal, Sludge disposal.

The characteristics of raw and mechanically fixed hazardous industrial wastes and flue gas desulfurization sludges were studied in a laboratory testing program. Raw and fixed sludges were examined for grain size distributions, Atterberg limits, specific gravities, relationships between volume, weight and moisture, and permeabilities. Compaction and unconfined compression tests and wet-dry and freeze-thaw tests for durability were performed on selected fixed sludge. Chemical fixing of the sludges resulted in significant changes in the sludge properties which were similar to soil, soil-cement, or low-strength concrete; the characteristics were dependent upon the fixing process. Fixed sludge demonstrated substantial engineering strength and were considered suitable for landfill and embankment construction. Weathering of fixed sludge may be a problem unless the sludges are covered with earth. Leaching data is contained in an interim report. (Lisk-FRC)  
W80-00243

### 8I. Fisheries Engineering

**EMERGENCY AERATION OF FISH PONDS.**  
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.  
C. E. Boyd, and C. S. Tucker.  
Transactions of the American Fisheries Society, Vol. 108, No. 3, p 299-306, May 1979. 2 fig, 7 tab, 17 ref. OWRT B-076-ALA.

**Descriptors:** \*Ponds, \*Fish, \*Aeration, Dissolved oxygen, Pumping, Mixing, Circulation, Water circulation, Farm ponds, Phytoplankton, Oxygen, Equipment, On-site investigations, Evaluation, Measurement, Agriculture, \*Fish farming.

Dissolved oxygen (DO) concentrations were depressed in 0.37-hectare fish ponds through algicide treatment, and the effectiveness of different techniques of emergency aeration was compared. The most effective device for emergency aeration was a paddle-wheel aerator powered by a tractor. A tractor-powered Crisafulli pump with a discharge capacity of 18.9 cu m/minute was also a relatively effective aeration device when used either to spray DO-deficient water into the air and back into the pond or to pump fresh, oxygenated water from another pond into the one with low DO concentration. A lower capacity Rainmaster pump (3.8 cu m/minute) was much less effective than the Crisafulli pump when used to discharge oxygenated water into a DO-depleted pond. Neither of the pumps raised DO concentrations appreciably when used to circulate DO-deficient water in ponds. Three sizes (0.25, 2.2, and 3.7 kilowatts) of spray-type surface aerators failed to appreciably increase DO concentrations. (Sims-ISWS)  
W80-00192

**FLOOD ELEVATIONS FOR THE SOOES RIVER AT PROPOSED FISH HATCHERY, CLALLAM COUNTY, WASHINGTON - A SURFACE-WATER SITE STUDY.**  
Geological Survey, Tacoma, WA. Water Resources Div.  
J. H. Bartels.  
Geological Survey Water-Resources Investigation 78-130 (open-file report), 1979. 28 p, 4 fig, 6 ref.

**Descriptors:** \*Flood frequency, \*Forecasting, \*Baseline studies, \*Analytical techniques, \*Elevation, Tides, Water levels, Streamflow, Discharge (Water), Construction, Sites, Fish hatch-

eries, \*Clallam County(WA), \*Snoos River(WA),  
\*Neah Bay(WA).

Water-surface elevations were derived for various combinations of selected river discharges and tide elevations along a reach of the Snoos River 3 miles upstream from the mouth at the site of a proposed fish hatchery in Clallam County, Washington. Flood-frequency analyses determined river discharges having exceedence probabilities of 1, 2, 4, 10 and 20 percent (100-, 50-, 25-, 10-, and 5-year recurrence intervals) and tide elevations having exceedence probabilities of 1 and 50 percent (100- and 2-year recurrence intervals). A relationship was developed for determining river water-surface elevation for different combinations of river discharge and tide elevations. Seven different combinations of river flood-plain conditions that may be expected to occur during and after construction were simulated and water-surface elevations determined by use of the step-backwater computer program.

W80-00231



# SUBJECT INDEX

## ABSORPTION

Botanical Control: Purifying Industrial Wastewater, W80-00266 5D

The Uptake of <sup>226</sup>Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A

Accumulation of Cadmium by Dunaliella Tertiolecta Butcher, W80-00398 5A

## ACID MINE WATER

The Pumping of Water from Mines in the Central Witwatersrand, W80-00260 5D

## ACIDIC WATER

Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124 5D

Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A

## ACIDITY

Acidification of Headwater Streams in the New Jersey Pine Barrens, W80-00354 5B

## ACTIVATED CARBON

Overview of Physical-Chemical Treatment, W80-00098 5D

The Operation of the Physical-Chemical Plant at Rosemount, Minnesota, W80-00100 5D

The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D

Design of Facilities for Physical-Chemical Treatment of Raw Wastewater, W80-00104 5D

Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex, W80-00112 5D

## ACTIVATED SLUDGE

Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118 5D

Sewage Treatment - The State of the Art, W80-00261 5D

Roodepoort Now Handles Own Wastewater, W80-00267 5D

## ADMINISTRATIVE AGENCIES

Water Quality Management, Accomplishments Compendium I, W80-00242 6E

Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275 3B

## ADRIATIC SEA

On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079 2L

## ADSORPTION

The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D

Design of Facilities for Physical-Chemical Treatment of Raw Wastewater, W80-00104 5D

## AERATED LAGOONS

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

## AERATION

Salmon Processing Wastewater Treatment, W80-00140 5D

Emergency Aeration of Fish Ponds, W80-00192 8I

## AEROSOLS

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

## AGRICULTURE

The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

## AIR-WATER INTERFACES

Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K

## ALABAMA

Water Resources Data for Alabama, Water Year 1978, W80-00235 7C

## ALASKA

Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A

Alaska Native Water Rights as Affected by the Alaska Native Claims Settlement Act, W80-00371 6E

## ALGAE

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

Plants and Animals of the Estuary, W80-00300 2L

Plant Life of the Estuary, W80-00301 2L

## ALGAE CONTROL

Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D

## ALGAL ASSAYS

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

## ALGAL CONTROL

Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

## ALLIGATOR WEED CONTROL

Weed Control Methods for River Basin Management, W80-00323 2I

## ALLOGENIC SUCCESSION

Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B

## ALPINE

Primary Productivity of Alpine Meadow Communities, W80-00324 2G

## ALTERNATE PLANNING

Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272 5D

Management Alternatives for Santa Cruz Basin Groundwater, W80-00296 6A

## ALTERNATIVE PLANNING

An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B

Wastewater Effluent-An Element of Total Water Resource Planning, W80-00284 3C

Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290 3B

Model for Selection of Stormwater Control Alternatives, W80-00318 6B

## AMAZON RIVER

Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J

## AMMONIA

Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K

Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108 5D

The Contribution of Ammonia Excreted by Zooplankton to Phytoplankton Production in Narragansett Bay, W80-00399 5A

## ANAEROBIC DIGESTION

Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D

Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E

## ANALYSIS

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

## ANALYTICAL TECHNIQUES

Theory and Application of Environmental Economics, W80-00027 6A

Determination of Hydrodynamic Dispersion Coefficients Using 'Inverfc', W80-00073 5B

A Direct Solution to the Inverse Problem in Groundwater Flow, W80-00081 2F

Comparison of Finite Element and Finite Difference Methods in Thermal Discharge Investigations, W80-00082 5B

Boundary Element Method for Fluid Flow, W80-00083 8B

Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties, W80-00115 5D

# SUBJECT INDEX

## ANALYTICAL TECHNIQUES

- Water Analysis, W80-00217 1A
- Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B
- An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B
- Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I
- Ridge Regression-Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350 2B
- ANIMALS**
- Estuarine Animals, W80-00302 2L
- ANNUAL**
- United States Geological Survey Yearbook, Fiscal Year 1978, W80-00236 7C
- AQUATIC ENVIRONMENT**
- Perspectives on Lake Ecosystem Modeling, W80-00204 2H
- Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H
- Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H
- Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H
- An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A
- AQUATIC HABITAT**
- Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G
- Stream Channel Modification in Hawaii. Part B: Effect of Channelization on the Distribution and Abundance of Fauna in Selected Streams, W80-00004 6G
- AQUATIC INSECTS**
- Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A
- AQUATIC LIFE**
- Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C
- Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C
- AQUATIC PLANTS**
- Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania, W80-00029 2I

- Botanical Control: Purifying Industrial Wastewater, W80-00266 5D
- Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition, W80-00298 2I
- Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I
- Weed Control Methods for River Basin Management, W80-00323 2I
- Silica and Ash in the Salt Marsh Rush, *Juncus Roemerianus*, W80-00325 2I
- AQUIFER CHARACTERISTICS**
- Ground-Water Resources of Washington Parish, Louisiana, W80-00227 2F
- Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K
- AQUIFERS**
- The Significance of the Storage Parameter in Saturated-Unsaturated Groundwater Flow, W80-00094 2F
- Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979, W80-00230 2F
- Exact Aquitard Response Functions for Multiple Aquifer Mechanics, W80-00356 2F
- Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F
- AQUITARDS**
- Exact Aquitard Response Functions for Multiple Aquifer Mechanics, W80-00356 2F
- ARCTIC**
- A Dynamic Thermodynamic Sea Ice Model, W80-00084 2C
- Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A
- ARIZONA**
- Arizona Groundwater Law Reform - An Urban Perspective, W80-00271 6E
- ARKANSAS**
- Trichlorofluoromethane in Groundwater-A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F
- ARTIFICIAL SUBSTRATES**
- Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G
- ASYMPTOTIC BEHAVIOR**
- Comment on 'Value of Information in Reservoir Optimization' by V. Klemes, W80-00147 6A
- ATIGUN RIVER**
- Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A

- AUTOGENIC SUCCESSION**
- Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B
- AZOMETHINE H COLORIMETRIC METHOD**
- Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B
- BACTERIA**
- Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments, W80-00016 2I
- BAKER COUNTY**
- Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226 2F
- BALTIC SEA**
- Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B
- BASELINE STUDIES**
- Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A
- Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I
- BEACH EROSION**
- Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan, W80-00348 2J
- BEACHES**
- Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173 5B
- BENTHIC FAUNA**
- Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A
- BENTHIC FLORA**
- Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A
- BENTHOS**
- Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C
- BIOACCUMULATION**
- Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- The Uptake of <sup>226</sup>Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A
- Accumulation of Cadmium by *Dunaliella Tertiolecta* Butcher, W80-00398 5A
- BIOASSAY**
- Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D

# SUBJECT INDEX

## CHANNELS

### BIOCHEMICAL OXYGEN DEMAND

Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D

Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A

BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353 5D

### BIOGENIC HYDROCARBONS

Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C

### BIOINDICATORS

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

### BIOLOGICAL COMMUNITIES

Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B

### BIOLOGICAL TREATMENT

Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108 5D

Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D

Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives, W80-00135 5D

Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D

The Economic Implications of Water Re-Use, W80-00257 5D

Current Technology and Research on Re-Use of Effluents, W80-00258 5D

Sewage Treatment - The State of the Art, W80-00261 5D

### BIOLOGY

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

### BIOMASS

Seasonal Changes of Phragmites Communis Trin. Part I. Growth, Morphometrics, Density and Biomass, W80-00011 2I

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

Primary Productivity of Alpine Meadow Communities, W80-00324 2G

### BLACK BOX MODELS

Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H

### BOGS

Contribution to the Study of Some Bryoassociations of the Subalpine Zone in the Southeast of France (Contribution a l'etude de Quelques

Bryoassociations de l'etage Subalpine Dans le Sud-est de la France), W80-00006 2I

The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

### BOISE RIVER (IDAHO)

Comparing Water Supply Forecast Techniques, W80-00202 2A

### BORON

Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B

### BOTTOM SEDIMENTS

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

### BOUNDARY DISPUTES

The Anglo-French Continental Shelf Case, W80-00366 6E

### BOUNDARY ELEMENT METHOD

Boundary Element Method for Fluid Flow, W80-00083 8B

### BOUNDARY PROCESSES

Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K

Boundary Element Method for Fluid Flow, W80-00083 8B

### BREEDING

Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I

### BRINES

Reuse of Brines in Commercial Cucumber Fermentations, W80-00128 5D

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

Reuse of Fermentation Brines in the Cucumber Pickling Industry, W80-00251 5D

### BROOKS RANGE

Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A

### BROWN TROUT

Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A

### BUBBLES

Bubble Populations and Spectra in Coastal Waters: A Photographic Approach, W80-00352 2L

### BYPRODUCTS

Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124 5D

Recovery of Soluble Serum Proteins from Meat Industry Wastes, W80-00132 5D

Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D

Potato Juice Processing, W80-00136 5D

Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry, W80-00137 5D

### CADMIUM

Accumulation of Cadmium by Dunaliella Tertiolecta Butcher, W80-00398 5A

### CALIFORNIA

Real-Time Flood Forecasting for Southern California, W80-00340 2E

The Role of the Permit System in the California Coastal Strategy, W80-00364 6E

The Coastal Commissions and State Agencies: Conflict and Cooperation, W80-00365 6E

Re-Use of Foreign Waters, W80-00384 6E

### CANADA

Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H

Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A

Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A

Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345 5A

### CARBOHYDRATES

Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021 2I

### CARBON

BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353 5D

### CARROTS

An Effective Wastewater Management Program for a Food Processor, W80-00130 5D

### CATIONS

Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D

### CENSUS

Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G

Fishery Survey of Cedar Lakes and the Brazos and San Bernard River Estuaries, W80-00305 2H

Peatland Policy Study, W80-00317 6E

### CHANNEL CATFISH

Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, Ictalurus Punctatus, W80-00395 5A

### CHANNELS

The Fluvial System: Selected Observations, W80-00019 2E

# SUBJECT INDEX

## CHEMICAL ANALYSIS

### CHEMICAL ANALYSIS

- Water Analysis,  
W80-00217 1A
- Azomethine H Colorimetric Method for Determining Dissolved Boron in Water,  
W80-00221 1B
- An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing,  
W80-00229 7B
- Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition,  
W80-00298 2I

### CHEMICAL INDUSTRY

- 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Held at the Taft Center, Cincinnati, Ohio, November 12-14, 1975.  
W80-00097 5D
- Treatment of Chemical Plant Effluents,  
W80-00101 5D
- Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex,  
W80-00112 5D
- Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry,  
W80-00249 6B

### CHEMICAL PROPERTIES

- The Role of Activated Carbon in Physico-Chemical Treatment,  
W80-00102 5D
- Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada,  
W80-00232 2K
- Heavy Metals and Wastewater Reuse,  
W80-00282 5B

### CHEMICAL REACTIONS

- 2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Held at the Taft Center, Cincinnati, Ohio, November 12-14, 1975.  
W80-00097 5D
- Overview of Physical-Chemical Treatment,  
W80-00098 5D
- Comparison of Alternative Strategies for Coke Plant Wastewater Disposal,  
W80-00108 5D

### CHEMICAL WASTES

- Treatment of Chemical Plant Effluents,  
W80-00101 5D
- Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex,  
W80-00112 5D
- Heavy Metals and Wastewater Reuse,  
W80-00282 5B

### CHEMISTRY OF PRECIPITATION

- Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation,  
W80-00086 5A
- Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario,  
W80-00344 5A
- Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects,  
W80-00345 5A

### CHLORDANE

- Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*,  
W80-00392 5C

### CHLORELLA

- Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent,  
W80-00193 5A

### CHLORIDES

- Economic Return on Pollution Control Expenditures for the Pickled Food Industry,  
W80-00131 5D
- The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water,  
W80-00263 5E

### CHLORINATION

- Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery,  
W80-00118 5D
- Current Technology and Research on Re-Use of Effluents,  
W80-00258 5D
- Operation and Control of Water Purification Plants, Part II,  
W80-00262 5E
- Richards Bay Mzingazi Water Purification Works,  
W80-00268 5F

### CHLORINE DIOXIDE

- Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide,  
W80-00109 5D

### CHLOROPHYTA

- Accumulation of Cadmium by *Dunaliella Tertiolecta* Butcher,  
W80-00398 5A

### CLALLAM COUNTY (WA)

- Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study,  
W80-00231 8I

### CLEAN AIR ACT

- Air and Water Pollution Policy,  
W80-00380 6E

### CLEAN WATER ACT

- Compensating States and the Federal Government for Damages to Natural Resources Resulting from Oil Spills,  
W80-00387 6E

### CLOGGING

- Trickle Irrigation: Prevention of Clogging,  
W80-00074 5F

### CLOUD PHYSICS

- Solar Radiation as Indexed by Clouds for Snow-melt Modeling,  
W80-00292 2C

### COAGULATION

- Studies on Wastewater Treatment with Flocculants Application,  
W80-00099 5D
- Design of Facilities for Physical-Chemical Treatment of Raw Wastewater,  
W80-00104 5D
- Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams,  
W80-00121 5D

- Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives,  
W80-00135 5D

### COAL MINES

- Water Quality of Runoff from Surface Mined Lands in Northern Arizona,  
W80-00288 5B

### COALS

- Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges,  
W80-00243 8G

### COASTAL AREAS

- Plant Life of the Estuary,  
W80-00301 2L

### COASTAL ZONE MANAGEMENT

- Coastal Hazards and National Policy: A Jury-Rig Approach,  
W80-00370 6E

### COASTS

- Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations,  
W80-00069 2L
- Bubble Populations and Spectra in Coastal Waters: A Photographic Approach,  
W80-00352 2L
- The Role of the Permit System in the California Coastal Strategy,  
W80-00364 6E
- The Coastal Commissions and State Agencies: Conflict and Cooperation,  
W80-00365 6E

### COELASTRUM

- The Uptake of 226Ra by Planktonic Algae Under Conditions of Continuous Cultivation,  
W80-00394 5A

### COLD REGIONS

- Cold Regions Spill Response,  
W80-00158 5C

### COLIFORMS

- Cost Effective Approach for Combined Storm and Sewer Clean-Up,  
W80-00055 4A

### COLORADO

- Re-Use of Foreign Waters,  
W80-00384 6E

### COLORADO RIVER

- Trickle Irrigation: Prevention of Clogging,  
W80-00074 5F

### COMBINED SEWERS

- Impact of CSO/SSD on Water Quality,  
W80-00048 4A
- A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator,  
W80-00057 4A
- Model for Selection of Stormwater Control Alternatives,  
W80-00318 6B

### COMMERCIAL WATER USE

- Factors for Predicting Commercial Water Use,  
W80-00203 6D

### COMPRESSIBILITY

- The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow,  
W80-00090 2G

### COMPUTER MODELS

- Model for Selection of Stormwater Control Alternatives,  
W80-00318 6B

# SUBJECT INDEX

## DETRITUS

Processing ent Al-	CONCRETE SUBSTRATE (CACO3) Algal Assays for Areas Receiving or Pro- grammed to Receive Sewage Effluent, W80-00193	5A	Stochastic Optimization of a Water Supply System, W80-00397	6A	United States Geological Survey Yearbook, Fiscal Year 1978, W80-00236	7C
5D						
Mined	CONNECTICUT Plant Life of the Estuary, W80-00301	2L	COSTS Land Management Techniques for Stormwater Control in Developed Urban Areas, W80-00052	4C	Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mis- sissippi, W80-00241	6A
5B						
Hazard-	CONSTRUCTION Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247	5D	Financing Storm Water Control Projects, W80-00065	4A	Design of the Dee Telemetry System with Com- puter Acquisition of Data, W80-00331	7B
8G						
2L	CONTAMINANT TRANSPORT Identification of Aquifer Dispersivities in Two- Dimensional Transient Groundwater Contami- nant Transport: An Optimization Approach, W80-00393	2F	Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121	5D	DATA INTERPRETATION Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205	2H
A Jury-						
6E	CONTINENTAL SHELF The Anglo-French Continental Shelf Case, W80-00366	6E	Treatment of Packinghouse Wastewater by Sand Filtration, W80-00129	5D	DATA PROCESSING Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337	7B
Gulf of Observa-	Sea Changes and the American Republic, W80-00383	6E	Aircraft Industry Wastewater Recycling, W80-00255	5D	Ridge Regression--Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350	2B
2L						
Coastal	COOLING Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351	2D	The Economic Implications of Water Re-Use, W80-00257	5D	DATA TRANSMISSION A Telemetry System Working Through the Public Telephone Network, W80-00339	2E
2L						
California	COOLING POND Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351	2D	Rising Energy Prices, Water Demand by Periur- ban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295	3F	DATING Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096	2F
6E						
Agencies:	COOLING WATER Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108	5D	Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Proj- ect, W80-00333	7B	DECOMPOSING ORGANIC MATTER Caloric, Elemental, and Nutritive Changes in Decomposing Juncus Roemerianus Leaves, W80-00307	2I
6E						
ic Algae	Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143	5D	CURVES Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276	2E	DEFORESTATION Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072	2C
5A						
5C	Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake, W80-00358	5B	CYCLING NUTRIENTS Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hamp- shire, W80-00201	2K	DEGRADATION Development of Microwave Plasma Detoxifica- tion Process for Hazardous Wastes. Phase 1, W80-00244	5D
ed Storm						
4A	CORROSION Corrosion and Scale-Formation Properties of Geopressed Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219	1A	D/RADEX Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337	7B	DENITRIFICATION Denitrification in a Salt Marsh Ecosystem, W80-00355	2L
6E						
ing, 5F	COST Effluent Generation, Energy Use and Cost of Blanching, W80-00122	5D	DAIRY INDUSTRY The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144	5D	DENSITY CURRENT Interfacial Stability in Channel Flow, W80-00297	2E
4A						
wer Over-	COST ANALYSIS State/Local Interaction in Stormwater Manage- ment, W80-00062	4A	DAMS Soil Investigations: Richelieu Dam Project, St. John's Shoal, St. John, St. John's County, Quebec. W80-00042	8D	DESIGN A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213	6A
4A						
Control Al-	COST-BENEFIT ANALYSIS Cost Benefits of Physical Chemical Treatment, W80-00113	5D	Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362	4B	DESIGN CRITERIA Design of Facilities for Physical-Chemical Treatment of Raw Wastewater, W80-00104	5D
6B						
Water Use,	Rising Energy Prices, Water Demand by Periur- ban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295	3F	DAMSDITES Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290	3B	Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, W80-00253	5D
6D						
Diffusivity	COST EFFECTIVE Model for Selection of Stormwater Control Al- ternatives, W80-00318	6B	Preliminary Analysis of Legal Obstacles and In- centives to the Development of Low-Head Hy- droelectric Power in the Northeastern United States, W80-00363	6E	DETENTION RESERVOIRS Legal Aspects of Urban Storm Water Manage- ment and Related Pollution Abatement Prob- lems, W80-00064	4A
2G						
Control Al-	COST MINIMIZATION A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213	6A	DATA COLLECTIONS Surface Water Data Manitoba 1978, W80-00195	4A	DETRITUS Probable Agents for the Formation of Detritus from the Halophyte, Spartina Alterniflora, W80-00036	2I
6B						
	Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362	4B	Surface Water Data Yukon and Northwest Ter- ritories 1978, W80-00196	4A		

## DEWATERING

### DEWATERING

Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment, W80-00114 5D

Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties, W80-00115 5D

Tomato Cleaning, Water Recycle and Mud Dewatering, W80-00120 5D

### DIETRICH RIVER

Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A

### DIFFUSION

Diffusion of Dissolved Gas in Consolidating Porous Media, W80-00095 2F

Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B

### DIFFUSIVITY

The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow, W80-00090 2G

### DIGESTION

Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I

### DIMENSIONAL ANALYSIS

Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, W80-00238 2A

### DISCHARGE (WATER)

Relative Accuracy of Connecting Channel Discharge Data with Application to Great Lakes Studies, W80-00347 2E

### DISPERSION

Determination of Hydrodynamic Dispersion Coefficients Using 'Inverfe', W80-00073 5B

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161 5C

The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C

Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F

### DISSOLVED CARBON

Comparison of Diurnal Fluctuations of Dissolved Inorganic Carbon and Algal Productivity Estimates in an Oligotrophic and Mesotrophic Freshwater Environment, W80-00002 5C

### DISSOLVED OXYGEN

Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A

## SUBJECT INDEX

### DISTRIBUTION PATTERNS

Floristics of the Middle Mississippi River Sand and Mud Flats, W80-00028 2I

Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania, W80-00029 2I

Beach and Salt Marsh Vegetation of the North American Pacific Coast, W80-00031 2I

### DOMESTIC WASTES

Rodepoort Now Handles Own Wastewater, W80-00267 5D

### DRAWDOWN

Effects of a Drawdown on a Waterfowl Impoundment, W80-00315 2H

### DROUGHTS

Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period, W80-00313 2H

### DUNALIELLA

Accumulation of Cadmium by Dunaliella Tertiolecta Butcher, W80-00398 5A

### DYE DISPERSION

Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B

### DYES

Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex, W80-00112 5D

### DYNAMIC PROGRAMMING

Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362 4B

Stochastic Optimization of a Water Supply System, W80-00397 6A

### ECOLOGICAL DISTRIBUTION

Contribution to the Study of Some Bryoassociations of the Subalpine Zone in the Southeast of France (Contribution a l'etude de Quelques Bryoassociations de l'etage Subalpine Dans le Sud-est de la France), W80-00006 2I

Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041 2I

### ECOLOGICAL EFFECTS

Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G

Stream Channel Modification in Hawaii. Part B: Effect of Channelization on the Distribution and Abundance of Fauna in Selected Streams, W80-00004 6G

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

### ECOLOGY

Theory and Application of Environmental Economics, W80-00027 6A

Remote Sensing as a Tool for Studying the Ecology of Halophytes, W80-00037 7B

Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189 5C

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H

The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H

Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H

Pyrite: Its Rapid Formation in a Salt Marsh and Its Importance to Ecosystem Metabolism, W80-00311 2K

Mangroves: A Review, W80-00319 2I

### ECONOMETRICS

Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B

### ECONOMIC FEASIBILITY

Wastewater Reuse-How Viable Is It. Another Look, W80-00283 5F

### ECONOMIC IMPACT

Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B

Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

### ECONOMIC JUSTIFICATION

Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295 3F

### ECONOMIC PREDICTION

Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295 3F

### ECONOMICS

Theory and Application of Environmental Economics, W80-00027 6A

The Potential Economic Uses of Halophytes, W80-00040 6C

Cost Benefits of Physical Chemical Treatment, W80-00113 5D

Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D

A Water Quality Economic Index, W80-00346 6B

### ECOSYSTEMS

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C

Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162 5C

# SUBJECT INDEX

## ENZYMES

The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186 5C

A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C

Perspectives on Lake Ecosystem Modeling, W80-00204 2H

Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H

The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H

An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

**EFFECTS**  
Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H

Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A

**EFFECTS OF PESTICIDES**  
Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303 2I

**EFFLUENT STREAMS**  
Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E

**EFFLUENTS**  
Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F

Wastewater Effluent-An Element of Total Water Resource Planning, W80-00284 3C

Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

**ELECTRIC POWER INDUSTRY**  
Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges, W80-00243 8G

**ELEVATION**  
Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I

## EMISSION SPECTROMETRY

An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B

## EMULSIONS

Treatment of Concentrated Waste Waters Containing Oil Emulsions, W80-00111 5D

## ENERGY

Geothermal Energy: Problems and Shortcomings of Classification of a Unique Resource-A Look at Problems with Water Law, with Particular Emphasis on New Mexico, W80-00388 6E

## ENGLAND

Rainfall Measurement by Radar, W80-00329 7B

A System for Real-Time Processing Transmission and Display of Radar-Derived Rainfall Data, W80-00330 7B

Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B

Installation and Operation of the Dee Telemetry System, W80-00332 7B

Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

Control Rules for Long and Short Term Objectives, W80-00335 2E

Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B

## ENVIRONMENTAL CONTROL

Theory and Application of Environmental Economics, W80-00027 6A

Formulation and Testing of a New Water Quality Index, W80-00304 7B

Planning for Environmental Management: New Directions and Initiatives, W80-00386 6E

## ENVIRONMENTAL EFFECTS

Control of Salt Marsh Culicoides and Tabanus Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013 5C

The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

Effects of Ground Applications of Malathion on Saltmarsh Environments in Northwestern Florida, W80-00025 5C

Planning to Narrow the Implementation Gap, W80-00067 4A

Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C

Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C

Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162 5C

Ecological Impacts of Oil Spill Cleanup: Are They Significant, W80-00163 5C

A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164 5C

Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C

Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C

Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C

The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, Rhithropanopeus Harrisi, W80-00172 5C

Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173 5B

Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187 5C

Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G

Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303 2I

Utilization of Oxygen Models in Environmental Impact Analysis, W80-00312 5C

**ENVIRONMENTAL QUALITY**  
Theory and Application of Environmental Economics, W80-00027 6A

**ENVIRONMENTAL SANITATION**  
Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272 5D

**ENZYMES**  
Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, Ictalurus punctatus, W80-00395 5A

Effect of Distillery Waste on Some Freshwater Teleosts-Biochemical Studies, W80-00396 5B

# EPHEMERAL STREAMS

# SUBJECT INDEX

## EPHEMERAL STREAMS

Ephe-meral Flow and Water Quality Problems:  
A Case Study of the San Pedro River in South-  
eastern Ariz.,  
W80-00281 2E

Geomorphic Features Affecting Transmission  
Loss Potential on Semiarid Watersheds,  
W80-00289 2J

## EQUATIONS

Sediment Yield Equation from an Erosion Simu-  
lation Model,  
W80-00280 2J

## EROSION CONTROL

SCS Practices as Related to Sediment and Ero-  
sion Control,  
W80-00054 4D

## ERROR ANALYSIS

Empirical Lake Models for Phosphorus: Devel-  
opment, Applications, Limitations and Uncer-  
tainty,  
W80-00212 2H

## ESTIMATING EQUATION

Sediment Yield Equation from an Erosion Simu-  
lation Model,  
W80-00280 2J

## ESTUARIES

A Tidal Simulation System for Estuarine Eco-  
system Research,  
W80-00191 5C

Plants and Animals of the Estuary,  
W80-00300 2L

Plant Life of the Estuary,  
W80-00301 2L

Estuarine Animals,  
W80-00302 2L

Fishery Survey of Cedar Lakes and the Brazos  
and San Bernard River Estuaries,  
W80-00305 2H

Freshwater and the Florida Coast: Southwest  
Florida,  
W80-00367 6E

## EUTROPHICATION

Hypolimnetic Oxygen Depletion in Central  
Lake Erie: Has There Been Any Change,  
W80-00197 2H

Regional Analysis of Economic Activity, Re-  
source Management and Lake Eutrophication: A  
Case Study of Itasca County, Minnesota,  
W80-00254 5C

## EVALUATION

An Economic and Environmental Evaluation of  
Alternative Land Development Around Lakes,  
W80-00148 6B

Guidelines for the Use of Structural Versus Re-  
gression Analysis in Geomorphic Studies,  
W80-00224 7B

## EVALUATIONS

Field Manual for Performance Evaluation and  
Troubleshooting at Municipal Wastewater  
Treatment Facilities,  
W80-00253 5D

## EVAPORATION

The Removal of Volatile Suspended Solids from  
Wastewaters,  
W80-00103 5D

The Priestley-Taylor Evaporation Model Ap-  
plied to a Large, Shallow Lake in the Nether-  
lands,  
W80-00349 2D

## EXCHANGE COEFFICIENTS

Rate of Loss of Ammonia from Water to the  
Atmosphere,  
W80-00075 2K

## EXPERIMENTS

Water Column Death and Decomposition of  
Phytoplankton: An Experimental and Modeling  
Review,  
W80-00206 2H

## FALLOUT

Direct Observations of Aerosols Attached to  
Falling Snow Crystals,  
W80-00080 2C

## FEASIBILITY STUDIES

Water Reuse of Wastewater from a Poultry  
Processing Plant,  
W80-00142 5D

Reuse of Fermentation Brines in the Cucumber  
Pickling Industry,  
W80-00251 5D

Aircraft Industry Wastewater Recycling,  
W80-00255 5D

## FEATHER RIVER (CA)

Data Compilation of Periphyton Colonized on  
Artificial Substrates Placed in the Sacramento  
and Feather Rivers, California, 1975,  
W80-00223 6G

## FEDERAL PROJECT POLICY

The Quiet Before the Shootout Over 'The Water  
Law of the West',  
W80-00360 6E

## FEDERAL RESERVATIONS

Response to GAO Water Report.  
W80-00372 6E

Water Rights: The Issue and the Courts,  
W80-00376 6E

## FEDERAL-STATE WATER RIGHTS

CONFLICTS  
Sea Changes and the American Republic,  
W80-00383 6E

## FEDERAL WATER POLLUTION CONTROL

ACT  
Status of EPA's Effluent Guidelines for the  
Food Industry,  
W80-00117 6E

Water Quality Management Accomplishments  
Compendium I.  
W80-00242 6E

Air and Water Pollution Policy,  
W80-00380 6E

## FERMENTATION

Reuse of Brines in Commercial Cucumber Fer-  
mentations,  
W80-00128 5D

Reduction of Wastes from Cucumber Pickle  
Processing by Use of the Controlled Culture  
Fermentation Process,  
W80-00139 5D

## FERTILIZERS

Nutrient Limitation in Salt Marsh Vegetation,  
W80-00039 2I

## FILTERS

Nitrogen Removal from Secondary Effluent Ap-  
plied to a Soil-Turf Filter,  
W80-00274 5F

## FILTRATION

Overview of Physical-Chemical Treatment,  
W80-00098 5D

Treatment of Concentrated Waste Waters Con-  
taining Oil Emulsions,  
W80-00111 5D

Advanced Wastewater Treatment for an Orga-  
nic Chemicals Manufacturing Complex,  
W80-00112 5D

Effluent Polishing and Wastewater Reuse at  
Snokist Growers Cannery,  
W80-00118 5D

Treatment of Packinghouse Wastewater by Sand  
Filtration,  
W80-00129 5D

Economic Return on Pollution Control Expen-  
ditures for the Pickled Food Industry,  
W80-00131 5D

Improved Biological Treatment of Food Pro-  
cessing Wastes with Two-Stage ABF Process,  
W80-00133 5D

Operation and Control of Water Purification  
Plants, Part II,  
W80-00262 5E

Pressure Filters for Specialised Wastewater  
Treatment,  
W80-00264 5D

Richards Bay Mzingazi Water Purification  
Works,  
W80-00268 5F

## FINANCING

Financing Storm Water Control Projects,  
W80-00065 4A

Financing Stormwater Projects,  
W80-00066 4A

## FISH

Relationship of Vertebrates to Salt Marsh Plants,  
W80-00038 2I

Emergency Aeration of Fish Ponds,  
W80-00192 8I

Plants and Animals of the Estuary,  
W80-00300 2L

Estuarine Animals,  
W80-00302 2L

## FISH FARMING

Emergency Aeration of Fish Ponds,  
W80-00192 8I

## FISH MANAGEMENT

The Managerial Fisheries,  
W80-00378 6E

## FISH PHYSIOLOGY

Pesticide Induced Haematological Alterations in  
a Fresh Water Fish *Saccobranchus Fossilis*,  
W80-00392 5C

## FISHERIES

A Fishery-Oil Spill Interaction Model,  
W80-00150 5C

Oil Spill Treatment Strategy Modeling for  
Georges Bank,  
W80-00185 5C

Fishery Survey of Cedar Lakes and the Brazos  
and San Bernard River Estuaries,  
W80-00305 2H

## FLOCCULATION

Studies on Wastewater Treatment with Floccu-  
lants Application,  
W80-00099 5D

Synthesis of Cationic Polyelectrolytes for Treat-  
ment of Natural and Waste Waters,  
W80-00105 5D

# SUBJECT INDEX

## FOOD PROCESSING WASTES

- aters Con-  
SD
- an Organ-  
SD
- Reuse at  
SD
- er by Sand  
SD
- l Expend-  
SD
- ood Proc-  
SD
- urification  
SD
- Wastewater  
SD
- urification  
SD
- ts,  
4A
- 4A
- sh Plants,  
2I
- 8I
- 2L
- 2L
- 8I
- 6E
- erations in  
SD
- SD
- elting for  
SD
- he Brazos  
SD
- 2H
- h Floccu-  
SD
- for Treat-  
SD
- The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water, W80-00263 5E
- Richards Bay Mzingazi Water Purification Works, W80-00268 5F
- FLOOD CONTROL**  
Control Rules for Long and Short Term Objectives, W80-00335 2E
- A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- Real-Time Flood Forecasting for Southern California, W80-00340 2E
- FLOOD DATA**  
Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A
- FLOOD FLOW**  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A
- FLOOD FORECASTING**  
Field Projects Executed by WMO on Flood Forecasting and Warning, Using Radar and/or Integrated Telemetry Systems, W80-00338 2E
- A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- Real-Time Flood Forecasting for Southern California, W80-00340 2E
- FLOOD FREQUENCY**  
Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I
- FLOOD PLAIN INSURANCE**  
Coastal Hazards and National Policy: A Jury-Rig Approach, W80-00370 6E
- FLOOD PLAIN ZONING**  
Coastal Hazards and National Policy: A Jury-Rig Approach, W80-00370 6E
- FLOOD PLAINS**  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- FLOOD PROFILES**  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- FLOOD RECURRENCE INTERVAL**  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- FLOODING**  
The Influence of Salinity, Inundation and Temperature on the Germination of Some Halophytes and Non-Halophytes, W80-00022 2I
- FLOODPLAIN**  
Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041 2I
- FLOODPLAINS**  
Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B
- FLOODS**  
Field Projects Executed by WMO on Flood Forecasting and Warning, Using Radar and/or Integrated Telemetry Systems, W80-00338 2E
- FLORIDA**  
Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041 2I
- FLOTATION**  
Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D
- FLOW**  
The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow, W80-00090 2G
- Relative Accuracy of Connecting Channel Discharge Data with Application to Great Lakes Studies, W80-00347 2E
- FLOW CONTROL**  
Control Rules for Long and Short Term Objectives, W80-00335 2E
- FLOW MEASUREMENT**  
Surface Water Data Manitoba 1978, W80-00195 4A
- FLOW RATES**  
Surface Water Data Manitoba 1978, W80-00195 4A
- Surface Water Data Yukon and Northwest Territories 1978, W80-00196 4A
- FLUID MECHANICS**  
Boundary Element Method for Fluid Flow, W80-00083 8B
- FLUOROCARBONS**  
Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005 5G
- FOOD CHAINS**  
An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A
- FOOD PROCESSING INDUSTRY**  
Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington, W80-00116 5D
- Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118 5D
- Tomato Cleaning, Water Recycle and Mud Dewatering, W80-00120 5D
- Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D
- Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124 5D
- Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E
- Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D
- Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E
- Reuse of Brines in Commercial Cucumber Fermentations, W80-00128 5D
- Treatment of Packinghouse Wastewater by Sand Filtration, W80-00129 5D
- An Effective Wastewater Management Program for a Food Processor, W80-00130 5D
- Economic Return on Pollution Control Expenditures for the Pickled Food Industry, W80-00131 5D
- Recovery of Soluble Serum Proteins from Meat Industry Wastes, W80-00132 5D
- Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D
- Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D
- Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives, W80-00135 5D
- Potato Juice Processing, W80-00136 5D
- Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry, W80-00137 5D
- Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D
- Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D
- Salmon Processing Wastewater Treatment, W80-00140 5D
- Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D
- Water Reuse of Wastewater from a Poultry Processing Plant, W80-00142 5D
- Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143 5D
- Reuse of Fermentation Brines in the Cucumber Pickling Industry, W80-00251 5D
- FOOD PROCESSING WASTES**  
Status of EPA's Effluent Guidelines for the Food Industry, W80-00117 6E

# SUBJECT INDEX

## FOOD PROCESSING WASTES

Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D

Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D

Effluent Generation, Energy Use and Cost of Blanching, W80-00122 5D

## FORAGE PALATABILITY

Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I

## FORECASTING

Oil Spill Forecasting--Where Is It Going, W80-00181 5C

A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C

Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C

Comparing Water Supply Forecast Techniques, W80-00202 2A

Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B

## FOREIGN WATER

Re-Use of Foreign Waters, W80-00384 6E

## FOREST HYDROLOGY

Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hampshire, W80-00201 2K

## FOREST MANAGEMENT

Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C

Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A

## FOREST WATERSHEDS

Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hampshire, W80-00201 2K

Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A

## FORESTS

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

## FREON-II

Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F

## FRESHWATER

Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory, W80-00208 2H

Fishery Survey of Cedar Lakes and the Brazos and San Bernard River Estuaries, W80-00305 2H

Freshwater and the Florida Coast: Southwest Florida, W80-00367 6E

## FRESHWATER LAKES

Comparison of Diurnal Fluctuations of Dissolved Inorganic Carbon and Algal Productivity Estimates in an Oligotrophic and Mesotrophic Freshwater Environment, W80-00002 5C

## FRESHWATER MARSHES

Primary Productivity of Emergent Macrophytes in a Wisconsin Marsh Ecosystem, W80-00026 2I

Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I

Nitrogen Dynamics and Modeling in a Freshwater Wetland, W80-00327 2K

## GAGING STATIONS

Surface Water Data Manitoba 1978, W80-00195 4A

Surface Water Data Yukon and Northwest Territories 1978, W80-00196 4A

## GASES

The Removal of Volatile Suspended Solids from Wastewaters, W80-00103 5D

## GEOCHEMISTRY

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

## GEOMORPHOLOGY

The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L

Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154 5C

Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224 7B

Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289 2J

## GEOPRESSURED WATERS

Corrosion and Scale-Formation Properties of Geopressured Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A

## GEORGES BANK

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

## GEOHERMAL STUDIES

Corrosion and Scale-Formation Properties of Geopressured Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A

Geothermal Energy: Problems and Shortcomings of Classification of a Unique Resource-A Look at Problems with Water Law, with Particular Emphasis on New Mexico, W80-00388 6E

## GERMINATION

Comparative Ecological Requirements of a Perennial and an Annual Salicornia Species: Germination and Growth During the Early Stages of Development, (In French), W80-00010 2I

Halophyte Seed Germination, W80-00326 2I

## GRANTS

Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

## GRASSLANDS

Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I

Primary Productivity of Alpine Meadow Communities, W80-00324 2G

## GRAZING

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H

## GREAT LAKES

Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A

Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

Perspectives on Lake Ecosystem Modeling, W80-00204 2H

Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits, W80-00211 2H

The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H

Relative Accuracy of Connecting Channel Discharge Data with Application to Great Lakes Studies, W80-00347 2E

## GREAT SIPPESWISSETT MARSH (MA)

Denitrification in a Salt Marsh Ecosystem, W80-00355 2L

## GROUND WATER

Controls and Remedies for Ground Water - Caused Land Subsidence, W80-00389 6E

## GROUNDWATER

Solution of Linearized Boussinesq Equation with Stochastic Boundaries and Recharge, W80-00093 2F

Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F

Water Resources Data for Nebraska, Water Year 1978, W80-00234 7C

# SUBJECT INDEX

# IMPOUNDMENTS

Shortcom-  
Resource-A  
with Partic-  
  
6E  
  
s of a Pe-  
cies: Ger-  
arly Stages  
  
2I  
  
2I  
  
astewaters  
chemical In-  
  
5D  
  
eding Mal-  
  
2I  
  
low Com-  
  
2G  
  
odels: The  
  
2H  
  
nochlorine  
  
5A  
  
ter Levels  
ge,  
2H  
  
Sediments  
  
2K  
  
eling.  
2H  
  
the Great  
  
2H  
  
perties of  
Ecological  
  
2H  
  
annel Dis-  
eat Lakes  
  
2E  
  
em,  
2L  
  
Water -  
  
6E  
  
ation with  
  
2F  
  
water-A  
undwater  
  
2F  
  
a, Water  
  
7C

Water Resources Data for Alabama, Water Year 1978.  
W80-00235 7C  
  
Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977,  
W80-00239 7C  
  
Water Resources of the Zumbro River Watershed, Southeastern Minnesota,  
W80-00240 7C  
  
Use of Digital Models to Manage Ground Water,  
W80-00252 2F  
  
Arizona Groundwater Law Reform - An Urban Perspective,  
W80-00271 6E  
  
Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake,  
W80-00358 5B  
  
Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach,  
W80-00393 2F  
  
**GROUNDWATER AVAILABILITY**  
Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona,  
W80-00269 4B  
  
Management Alternatives for Santa Cruz Basin Groundwater,  
W80-00296 6A  
  
**GROUNDWATER BASINS**  
Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Groundwater Basin, California,  
W80-00238 2A  
  
Management Alternatives for Santa Cruz Basin Groundwater,  
W80-00296 6A  
  
**GROUNDWATER MOVEMENT**  
Stochastic Analysis of Steady State Groundwater Flow in a Bounded Domain 1. One-Dimensional Simulations,  
W80-00070 2F  
  
A Direct Solution to the Inverse Problem in Groundwater Flow,  
W80-00081 2F  
  
Solution of Linearized Boussinesq Equation with Stochastic Boundaries and Recharge,  
W80-00093 2F  
  
Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Groundwater Basin, California,  
W80-00238 2A  
  
**GROUNDWATER RESOURCES**  
Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon,  
W80-00226 2F  
  
Ground-Water Resources of Washington Parish, Louisiana,  
W80-00227 2F  
  
Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979,  
W80-00230 2F  
  
**GROWTH RATES**  
Seasonal Changes of Phragmites Communis Trin. Part I. Growth, Morphometrics, Density and Biomass,  
W80-00011 2I

Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank,  
W80-00085 2L  
  
**GROWTH STAGES**  
Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975,  
W80-00223 6G  
  
**GULF OF MAINE**  
Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations,  
W80-00069 2L  
  
**HALOPHYTES**  
Comparative Ecological Requirements of a Perennial and an Annual Salicornia Species: Germination and Growth During the Early Stages of Development, (In French),  
W80-00010 2I  
  
Growth and Salt Accumulation in Two Annual Species of Salicornia from the Mediterranean Coast, (In French),  
W80-00018 2I  
  
Role of Carbohydrate\*in Halophytes of the Region of Neusiedler Lake, Austria, (In German),  
W80-00021 2I  
  
Beach and Salt Marsh Vegetation of the North American Pacific Coast,  
W80-00031 2I  
  
A Review of Structure in Several North Carolina Salt Marsh Plants,  
W80-00032 2I  
  
Remote Sensing as a Tool for Studying the Ecology of Halophytes,  
W80-00037 7B  
  
The Potential Economic Uses of Halophytes,  
W80-00040 6C  
  
Halophyte Seed Germination,  
W80-00326 2I  
  
**HARBORS**  
Mass Exchange Between Hamilton Harbour and Lake Ontario,  
W80-00343 2H  
  
**HAWAII**  
Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota,  
W80-00003 6G  
  
Stream Channel Modification in Hawaii. Part B: Effect of Channelization on the Distribution and Abundance of Fauna in Selected Streams,  
W80-00004 6G  
  
Ridge Regression-Time Extrapolation Applied to Hawaiian Rainfall Normals,  
W80-00350 2B  
  
**HAZARDOUS SUBSTANCES**  
An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model,  
W80-00216 5A  
  
**HAZARDS**  
The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites,  
W80-00248 5B  
  
**HEAT TRANSFER**  
Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves,  
W80-00351 2D

**HEAVY METALS**  
Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,  
W80-00237 5C  
  
Heavy Metals and Wastewater Reuse,  
W80-00282 5B  
  
**HEMATOLOGY**  
Pesticide Induced Haematological Alterations in a Fresh Water Fish Saccobranchus Fossilis,  
W80-00392 5C  
  
**HISTORY**  
Use of Complex Paleogeographic Method to Recognize the History of Distrophic Lakes and High Bogs as Exemplified by an Interglacial Lake at Golkow Near Warszawa,  
W80-00007 2H  
  
**HYDRAULIC STRUCTURES**  
Soil Investigations: Richelieu Dam Project, St. John's Shoal, St. John, St. John's County, Quebec.  
W80-00042 8D  
  
**HYDRODYNAMIC DISPERSION**  
**COEFFICIENT**  
Determination of Hydrodynamic Dispersion Coefficients Using 'Inverse',  
W80-00073 5B  
  
**HYDRODYNAMICS**  
Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model,  
W80-00214 2H  
  
**HYDROELECTRIC PROJECT LICENSING**  
Preliminary Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in the Northeastern United States,  
W80-00363 6E  
  
**HYDROGEN ION CONCENTRATION**  
Depression of pH in Lakes and Streams in Central Ontario During Snowmelt,  
W80-00076 2H  
  
**HYDROGEN SULFIDE**  
Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes,  
W80-00119 5D  
  
**HYDROLOGIC BUDGET**  
Water Resources of the Zumbro River Watershed, Southeastern Minnesota,  
W80-00240 7C  
  
**HYDROLOGIC DATA**  
Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977,  
W80-00233 1A  
  
Water Resources Data for Nebraska, Water Year 1978.  
W80-00234 7C  
  
Water Resources Data for Alabama, Water Year 1978.  
W80-00235 7C  
  
**HYDROLOGIC PROPERTIES**  
Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona,  
W80-00269 4B  
  
**HYPOLIMNION**  
Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change,  
W80-00197 2H  
  
**IMPOUNDMENTS**  
Effects of a Drawdown on a Waterfowl Impoundment,  
W80-00315 2H

# SUBJECT INDEX

## INCINERATION

### INCINERATION

Stanger Pulp and Paper Mill - Clearing the Water.  
W80-00265 5D

### INDIAN RESERVATIONS

Alaska Native Water Rights as Affected by the Alaska Native Claims Settlement Act,  
W80-00371 6E

Response to GAO Water Report.  
W80-00372 6E

NCAI to GAO: Legislative Quantification of Indian Water Rights Is Not the Answer.  
W80-00373 6E

NCAI's Executive Council Meeting and Indian Water Rights.  
W80-00374 6E

Water Rights: The Issue and the Courts,  
W80-00376 6E

### INDIANS

NCAI to GAO: Legislative Quantification of Indian Water Rights Is Not the Answer.  
W80-00373 6E

NCAI's Executive Council Meeting and Indian Water Rights.  
W80-00374 6E

Water Rights: The Issue and the Courts,  
W80-00376 6E

### INDICES

Formulation and Testing of a New Water Quality Index,  
W80-00304 7B

A Water Quality Economic Index,  
W80-00346 6B

### INDUCTIVELY COUPLED PLASMA

An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing,  
W80-00229 7B

### INDUSTRIAL WASTES

Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington.  
W80-00116 5D

Tomato Cleaning, Water Recycle and Mud Dewatering,  
W80-00120 5D

Commercial Feasibility of Recovering Tomato Peeling Residuals,  
W80-00124 5D

Waste Reduction by Process Modification in Sweet Corn Processing,  
W80-00125 3E

Recovery of Soluble Serum Proteins from Meat Industry Wastes,  
W80-00132 5D

Single Cell Protein from Food Wastes by the Deep Tank Process,  
W80-00134 5D

Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives,  
W80-00135 5D

Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry,  
W80-00137 5D

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process,  
W80-00139 5D

Salmon Processing Wastewater Treatment,  
W80-00140 5D

Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements,  
W80-00141 5D

The Treatment and Disposal of Wastewater from Dairy Processing Plants,  
W80-00144 5D

Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges,  
W80-00243 8G

The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites,  
W80-00248 5B

Water Reuse in a Wet Process Hardboard Manufacturing Plant,  
W80-00250 5D

Immobilization of Hazardous Residuals by Encapsulation,  
W80-00256 5D

Stanger Pulp and Paper Mill - Clearing the Water.  
W80-00265 5D

Botanical Control: Purifying Industrial Wastewater,  
W80-00266 5D

Effect of Distillery Waste on Some Freshwater Teleosts-Biochemical Studies,  
W80-00396 5B

### INDUSTRIAL WATER

Treatment of Chemical Plant Effluents,  
W80-00101 5D

Tomato Cleaning, Water Recycle and Mud Dewatering,  
W80-00120 5D

Effluent Generation, Energy Use and Cost of Blanching,  
W80-00122 5D

Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment,  
W80-00123 5D

Toxicity of Some Canadian Fruit and Vegetable Processing Effluents,  
W80-00138 5D

Water Reuse in a Wet Process Hardboard Manufacturing Plant,  
W80-00250 5D

Aircraft Industry Wastewater Recycling,  
W80-00255 5D

The Economic Implications of Water Re-Use,  
W80-00257 5D

### INFILTRATION

Effects of Rainfall Intensity on Runoff Curve Numbers,  
W80-00276 2E

Simple Time-Power Functions for Rainwater Infiltration and Runoff,  
W80-00279 2G

A Microroughness Meter for Evaluating Rainwater Infiltration,  
W80-00291 2G

### INFORMATION

Comment on 'Value of Information in Reservoir Optimization' by V. Klemes,  
W80-00147 6A

### INHIBITION

Effect of Distillery Waste on Some Freshwater Teleosts-Biochemical Studies,  
W80-00396 5B

### INJECTION WELLS

Monitoring of Subsurface Injection of Wastes, Florida,  
W80-00222 5B

### INORGANIC COMPOUNDS

Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic,  
W80-00194 5C

### INPUT-OUTPUT ANALYSIS

Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota,  
W80-00254 5C

### INSECTICIDES

Effects of Ground Applications of Malathion on Saltmarsh Environments in Northwestern Florida,  
W80-00025 5C

Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario,  
W80-00341 5A

### INSTRUMENTATION

A Microroughness Meter for Evaluating Rainwater Infiltration,  
W80-00291 2G

Installation and Operation of the Dee Telemetry System,  
W80-00332 7B

### INTERFACIAL STABILITY

Interfacial Stability in Channel Flow,  
W80-00297 2E

### INTERNATIONAL LAW

The Anglo-French Continental Shelf Case,  
W80-00366 6E

International Environmental Implications of Soviet Development of the Volga River,  
W80-00368 6E

Who Will Reap the Mineral Riches of the Deep,  
W80-00375 6E

Alternative Regimes for the Ocean,  
W80-00377 6E

The Management Fisheries,  
W80-00378 6E

Offshore Oil and Gas Exploitation,  
W80-00379 6E

The Law of the Sea: A Rejoinder to Richard G. Darman,  
W80-00390 6E

### INTERNATIONAL WATERS

Who Will Reap the Mineral Riches of the Deep,  
W80-00375 6E

The Law of the Sea: A Rejoinder to Richard G. Darman,  
W80-00390 6E

### INVERTEBRATES

Plants and Animals of the Estuary,  
W80-00300 2L

Estuarine Animals,  
W80-00302 2L

The Relationship of Marine Macroinvertebrates to Salt Marsh Plants,  
W80-00321 2I

# SUBJECT INDEX

## LAW OF THE SEA

### ION EXCHANGE

The Operation of the Physical-Chemical Plant at Rosemount, Minnesota, W80-00100 5D

### IONIAN SEA

Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B

### IRON

Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment, W80-00114 5D

### IRRIGATION

Trickle Irrigation: Prevention of Clogging, W80-00074 5F

Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G

### IRRIGATION OPERATION AND MAINTENANCE

Trickle Irrigation: Prevention of Clogging, W80-00074 5F

### IRRIGATION PROGRAMS

The Quiet Before the Shootout Over 'The Water Law of the West', W80-00360 6E

### IRRIGATION WELLS

Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977, W80-00239 7C

### ISRAEL

Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G

### ITALY

On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079 2L

### JAPAN

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

### KENOGAMI WATERSHED

Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C

### KINETICS

Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K

### LABORATORY TESTS

Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K

Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank, W80-00085 2L

Water Analysis, W80-00217 1A

Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D

Immobilization of Hazardous Residuals by Encapsulation, W80-00256 5D

### LAGOONS

Surficial Sediments of Saldanha Bay and Langebaan Lagoon, W80-00012 2J

### LAKE ERIE

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H

### LAKE FLEVO (THE NETHERLANDS)

The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349 2D

### LAKE HURON

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

### LAKE MICHIGAN

A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A

Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan, W80-00348 2J

### LAKE NEUSIEDLER (AUSTRIA)

Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021 2I

### LAKE ONTARIO

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H

The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H

An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A

Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A

Mass Exchange Between Hamilton Harbour and Lake Ontario, W80-00343 2H

### LAKE ST CLAIR

Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H

### LAKES

Use of Complex Paleogeographic Method to Recognize the History of Distrophic Lakes and High Bogs as Exemplified by an Interglacial Lake at Golkow Near Warszawa, W80-00007 2H

Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H

An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B

Perspectives on Lake Ecosystem Modeling, W80-00204 2H

Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H

The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H

Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H

Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period, W80-00313 2H

Mass Exchange Between Hamilton Harbour and Lake Ontario, W80-00343 2H

The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349 2D

### LAND DEVELOPMENT

An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B

### LAND MANAGEMENT

Land Management Techniques for Developing Areas, W80-00053 4D

### LAND USE

The Role of the Permit System in the California Coastal Strategy, W80-00364 6E

The Coastal Commissions and State Agencies: Conflict and Cooperation, W80-00365 6E

Local Government Response to State-Mandated Land Use Laws, W80-00369 6E

### LANDFILLS

Development of a Synthetic Municipal Landfill Leachate, W80-00071 5E

Information About Hazardous Waste Management Facilities, W80-00245 5D

The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B

### LAW OF THE SEA

Alternative Regimes for the Ocean, W80-00377 6E

# SUBJECT INDEX

## LAW OF THE SEA

- The Managerial Fisheries,  
W80-00378 6E
- Offshore Oil and Gas Exploitation,  
W80-00379 6E
- Sea Changes and the American Republic,  
W80-00383 6E

## LEACHATE

- The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites,  
W80-00248 5B

## LEACHING

- Development of a Synthetic Municipal Landfill Leachate,  
W80-00071 5E

## LEAVES

- Silica and Ash in the Salt Marsh Rush, *Juncus Roemerianus*,  
W80-00325 2I

## LEGAL ASPECTS

- Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975 and Denver, Colorado, December 2-4, 1975.  
W80-00043 4A

- Legal Aspects of Urban Stormwater Management,  
W80-00063 4A

- Legal Aspects of Urban Storm Water Management and Related Pollution Abatement Problems,  
W80-00064 4A

- Financing Stormwater Projects,  
W80-00066 4A

- Water Quality Management Accomplishments Compendium I.  
W80-00242 6E

- Arizona Groundwater Law Reform - An Urban Perspective,  
W80-00271 6E

- Legal Aspects of Urban Runoff Development,  
W80-00293 6E

## LEGAL REVIEW

- Legal Aspects of Urban Runoff Development,  
W80-00293 6E

## LEVANTINE BASIN

- Tritium and Oxygen Profiles in the Eastern Mediterranean,  
W80-00078 5B

## LIGHT INTENSITY

- Response of Lake Phytoplankton Communities to In Situ Manipulations of Light Intensity and Colour,  
W80-00400 5A

## LIME

- Overview of Physical-Chemical Treatment,  
W80-00098 5D

- The Operation of the Physical-Chemical Plant at Rosemount, Minnesota,  
W80-00100 5D

- The Pumping of Water from Mines in the Central Witwatersrand,  
W80-00260 5D

## LITERATURE

- Mangroves: A Review,  
W80-00319 2I

## LITERATURE REVIEW

- Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements,  
W80-00237 5C

## LOCAL GOVERNMENTS

- The Intergovernmental Tangle Facing Stormwater Control,  
W80-00061 4D

- Planning to Narrow the Implementation Gap,  
W80-00067 4A

- Water Quality Management Accomplishments, Compendium I.  
W80-00242 6E

## LOUISIANA

- Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana,  
W80-00015 6G

## LOWER SANTA CRUZ AREA (AZ)

- Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona--1977,  
W80-00239 7C

## MAINE

- Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations,  
W80-00069 2L

## MALATHION

- Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment,  
W80-00303 2I

## MALLARDS

- Use of Prairie Pothole Habitat by Breeding Mallards,  
W80-00322 2I

## MANAGEMENT

- State/Local Interaction in Stormwater Management,  
W80-00062 4A

- Perspectives on Lake Ecosystem Modeling.  
W80-00204 2H

- Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits,  
W80-00211 2H

- Use of Digital Models to Manage Ground Water,  
W80-00252 2F

## MANGROVE SWAMPS

- Water Relations of Three Mangrove Species in South Florida,  
W80-00009 2I

- Salt Tolerance of Mangroves and Submerged Aquatic Plants,  
W80-00033 2I

- Mangroves: A Review,  
W80-00319 2I

## MANITOBA

- Surface Water Data Manitoba 1978.  
W80-00195 4A

## MAPS

- Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona--1977,  
W80-00239 7C

## MARINE FISHERIES

- Report to the Congress on Ocean Pollution Over Fishing, and Offshore Development (October 1976 Through September 1977).  
W80-00381 6E

## MARINE FUNGI

- Probable Agents for the Formation of Detritus from the Halophyte, *Spartina Alterniflora*,  
W80-00036 2I

## MARSH PLANTS

- Seasonal Changes of Phragmites Communities. Part I. Growth, Morphometrics, Density and Biomass,  
W80-00011 2I

- Adsorption and Accumulation of Pesticides Residues and Chlorinated Biphenyls in Both Wild Aquatic Vegetation and Rice in the Camargue Region, (In French),  
W80-00020 5B

- The Influence of Salinity, Inundation and Temperature on the Germination of Some Halophytes and Non-Halophytes,  
W80-00022 2I

- Primary Productivity of Emergent Macrophytes in a Wisconsin Marsh Ecosystem,  
W80-00026 2I

- Floristics of the Middle Mississippi River Sand and Mud Flats,  
W80-00028 2I

- Beach and Salt Marsh Vegetation of the North American Pacific Coast,  
W80-00031 2I

- A Review of Structure in Several North Carolina Salt Marsh Plants,  
W80-00032 2I

- Mathematical Modeling--Spartina,  
W80-00034 2I

- Probable Agents for the Formation of Detritus from the Halophyte, *Spartina Alterniflora*,  
W80-00036 2I

- Relationship of Vertebrates to Salt Marsh Plants,  
W80-00038 2I

- Nutrient Limitation in Salt Marsh Vegetation,  
W80-00039 2I

- The Potential Economic Uses of Halophytes,  
W80-00040 6C

- Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones,  
W80-00309 2I

- The Relationship of Marine Macroinvertebrates to Salt Marsh Plants,  
W80-00321 2I

## MARSHES

- Caloric, Elemental, and Nutritive Changes in Decomposing *Juncus Roemerianus* Leaves,  
W80-00307 2I

- Marsh Soils of the Atlantic Coast,  
W80-00320 2G

## MARYLAND

- The Intergovernmental Tangle Facing Stormwater Control,  
W80-00061 4D

## MASS BALANCE

- An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model,  
W80-00216 5A

## MASS TRANSFER

- Mass Exchange Between Hamilton Harbour and Lake Ontario,  
W80-00343 2H

## MASSACHUSETTS

- Denitrification in a Salt Marsh Ecosystem,  
W80-00355 2L

## MATHEMATICAL MODELS

- Mathematical Modeling--Spartina,  
W80-00034 2I

# SUBJECT INDEX

## MODEL STUDIES

- Considerations in Characterization of Urban Runoff for PL 92-500 Section 208 Planning, W80-00045 4A
- Impact of CSO/SSD on Water Quality, W80-00048 4A
- Non-Point Source Impact and Urban Holding Capacity, W80-00049 4C
- Applications of Stormwater Management Models, W80-00051 4A
- On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079 2L
- Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties, W80-00115 5D
- The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H
- The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H
- An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A
- Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Groundwater Basin, California, W80-00238 2A
- Utilization of Oxygen Models in Environmental Impact Analysis, W80-00312 5C
- Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E
- Real-Time Flood Forecasting for Southern California, W80-00340 2E
- A Water Quality Economic Index, W80-00346 6B
- MCPA**
- Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- MEASUREMENT**
- Method and Device for Determining the Pore Water Pressure in a Soil, W80-00110 2G
- A Microroughness Meter for Evaluating Rainwater Infiltration, W80-00291 2G
- MEDITERRANEAN SEA**
- Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B
- MEMBRANES**
- Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D
- MESOTROPHY**
- Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H
- METALS**
- Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A
- An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B
- METEORIC WATER**
- Water Recovery Device, W80-00030 2A
- METHODOLOGY**
- An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I
- Determination of Hydrodynamic Dispersion Coefficients Using 'Inverfc', W80-00073 5B
- Comparison of Finite Element and Finite Difference Methods in Thermal Discharge Investigations, W80-00082 5B
- Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C
- Formulation and Testing of a New Water Quality Index, W80-00304 7B
- A Water Quality Economic Index, W80-00346 6B
- Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F
- MICROBIAL DEGRADATION**
- Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D
- MICROBIAL-PESTICIDE INTERACTION**
- Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303 2I
- MICROCYSTIS**
- The Uptake of <sup>226</sup>Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A
- MICROORGANISMS**
- Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D
- Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I
- MICROWAVES**
- Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D
- MIGRATION**
- The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B
- MINE WASTES**
- The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C
- MINERALS**
- Studies on Wastewater Treatment with Flocculants Application, W80-00099 5D
- MINNESOTA**
- Minnesota Peat Program: Management Goals and Objectives and Policy Alternatives, W80-00316 6A
- MIREX**
- Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, *Ictalurus punctatus*, W80-00395 5A
- MISSISSIPPI RIVER**
- Floristics of the Middle Mississippi River Sand and Mud Flats, W80-00028 2I
- MODEL STRUCTURE**
- Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- MODEL STUDIES**
- Stochastic Analysis of Steady State Groundwater Flow in a Bounded Domain 1. One-Dimensional Simulations, W80-00070 2F
- Development of a Synthetic Municipal Landfill Leachate, W80-00071 5E
- Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C
- A Direct Solution to the Inverse Problem in Groundwater Flow, W80-00081 2F
- A Dynamic Thermodynamic Sea Ice Model, W80-00084 2C
- Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G
- A Stochastic Kinematic Study of Subsynchronous Space-Time Rainfall, W80-00092 2B
- Solution of Linearized Boussinesq Equation with Stochastic Boundaries and Recharge, W80-00093 2F
- Oil Spill Forecasting--Where Is It Going, W80-00181 5C
- A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C
- Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C
- Oil Spill Treatment Strategy Modeling for Georges Bank, W80-00185 5C
- Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A
- Comparing Water Supply Forecast Techniques, W80-00202 2A
- Perspectives on Lake Ecosystem Modeling, W80-00204 2H
- Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H

# MODEL STUDIES

- Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H
- Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory, W80-00208 2H
- Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits, W80-00211 2H
- Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H
- A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H
- Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Groundwater Basin, California, W80-00238 2A
- Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A
- Use of Digital Models to Manage Ground Water, W80-00252 2F
- The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277 8A
- Nitrogen Dynamics and Modeling in a Freshwater Wetland, W80-00327 2K
- The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349 2D
- BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353 5D
- MOISTURE CONTENT**  
Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- MOISTURE DEFICIT**  
Water Relations of Three Mangrove Species in South Florida, W80-00009 2I
- MONITORING**  
Impact of CSO/SSD on Water Quality, W80-00048 4A
- Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189 5C
- Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C
- Monitoring of Subsurface Injection of Wastes, Florida, W80-00222 5B

# SUBJECT INDEX

## MONTE CARLO METHOD

- Stochastic Analysis of Steady State Groundwater Flow in a Bounded Domain 1. One-Dimensional Simulations, W80-00070 2F

- Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

## MORTALITY

- Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G

## MOSSES

- The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

## MOVEMENT

- Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C

## MS CLEANER

- Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H

## MUD

- Tomato Cleaning, Water Recycle and Mud Dewatering, W80-00120 5D

## MUNICIPAL WASTES

- Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers, W80-00246 5D

- Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, W80-00253 5D

- Modernised System for Cape Town, W80-00259 5D

- Rooodepoort Now Handles Own Wastewater, W80-00267 5D

## MUNICIPAL WATER

- Tucson's Tools for Demand Management, W80-00270 6B

## MUTAGENS

- Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C

## NATIONAL PARKS

- Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E

## NATIONAL SEASHORES

- Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E

## NATURAL GAS

- Offshore Oil and Gas Exploitation, W80-00379 6E

## NATURAL RESOURCES

- United States Geological Survey Yearbook, Fiscal Year 1978, W80-00236 7C

## NEAH BAY (WA)

- Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I

## NEBRASKA

- Water Resources Data for Nebraska, Water Year 1978, W80-00234 7C

## NETWORK DESIGN

- Systematic Sampling of Gaussian Random Processes and Fields, W80-00089 2F

## NEUTRALIZATION

- Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment, W80-00114 5D

## NEW HAMPSHIRE

- An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B

## NEW JERSEY

- Trichlorofluoromethane in Groundwater-A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F

- Acidification of Headwater Streams in the New Jersey Pine Barrens, W80-00354 5B

## NEW MEXICO

- Geothermal Energy: Problems and Shortcomings of Classification of a Unique Resource-A Look at Problems with Water Law, with Particular Emphasis on New Mexico, W80-00388 6E

## NITRATES

- Sewage Treatment - The State of the Art, W80-00261 5D

## NITROGEN

- Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hampshire, W80-00201 2K

- Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F

- Nitrogen Dynamics and Modeling in a Freshwater Wetland, W80-00327 2K

## NITROGEN CYCLE

- Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

## NITROGEN FIXATION

- Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments, W80-00016 2I

## NONLINEAR PROGRAMMING

- Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A

## NORTH CAROLINA

- A Review of Structure in Several North Carolina Salt Marsh Plants, W80-00032 2I

## NORTHWEST TERRITORIES

- Surface Water Data Yukon and Northwest Territories 1978, W80-00196 4A

## NOZZLES

- The Removal of Volatile Suspended Solids from Wastewaters, W80-00103 5D

# SUBJECT INDEX

## OIL SPILLS

### NUTRIENT UPTAKE

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

### NUTRIENTS

The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition, W80-00298 2I

Factors Influencing Shoot Production and Mineral Nutrient Levels in Typha Latifolia, W80-00308 2I

### OAHU (HI)

Ridge Regression--Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350 2B

### OBSERVATION WELLS

Monitoring of Subsurface Injection of Wastes, Florida, W80-00222 5B

### OCEAN CIRCULATION

Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069 2L

### OCEANS

A Dynamic Thermodynamic Sea Ice Model, W80-00084 2C

Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B

Alternative Regimes for the Ocean, W80-00377 6E

Report to the Congress on Ocean Pollution Over Fishing, and Offshore Development (October 1976 Through September 1977), W80-00381 6E

### ODOR

Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D

### OHIO RIVER

Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania, W80-00029 2I

### OIL

Offshore Oil and Gas Exploitation, W80-00379 6E

### OIL AND GAS DISCOVERIES

Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A

### OIL INDUSTRY

Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D

### OIL POLLUTION

Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160 5C

Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C

The Occurrence of 'White Eye Syndrome' in Shrimp (Penaeus Aztecus), W80-00166 5C

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C

The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C

Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C

The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, Rhithropanopeus Harrisii, W80-00172 5C

Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173 5B

Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, Ilyanassa Obsoleta, W80-00174 5C

Hydrocarbons in Sediments from the Edge of the Bermuda Platform, W80-00175 5C

Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments, W80-00176 5C

C15+Hydrocarbons in the Sediments of the New York Bight, W80-00177 5C

Petroleum Hydrocarbons in the North Sea, W80-00178 5C

Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C

Selective Oil Spill Combat Planning for Offshore Exploration and Production Operations in the North Sea, W80-00180 5C

Effects of an Oil Slick on Wind Waves, W80-00183 5C

Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186 5C

Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C

Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189 5C

The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C

### OIL SPILLS

Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C

A Fishery-Oil Spill Interaction Model, W80-00150 5C

Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154 5C

Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

Cold Regions Spill Response, W80-00158 5C

The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants, W80-00159 5C

Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161 5C

Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162 5C

Ecological Impacts of Oil Spill Cleanup: Are They Significant, W80-00163 5C

A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164 5C

Selective Oil Spill Combat Planning for Offshore Exploration and Production Operations in the North Sea, W80-00180 5C

Oil Spill Forecasting--Where Is It Going, W80-00181 5C

A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C

Effects of an Oil Slick on Wind Waves, W80-00183 5C

# SUBJECT INDEX

## OIL SPILLS

Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C

Oil Spill Treatment Strategy Modeling for Georges Bank, W80-00185 5C

Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186 5C

Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187 5C

Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C

The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C

A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C

Compensating States and the Federal Government for Damages to Natural Resources Resulting from Oil Spills, W80-00387 6E

## OIL WASTES

Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

## OILY WATER

Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

Treatment of Concentrated Waste Waters Containing Oil Emulsions, W80-00111 5D

## ON-SITE INVESTIGATIONS

Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G

Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272 5D

Field Projects Executed by WMO on Flood Forecasting and Warning, Using Radar and/or Integrated Telemetry Systems, W80-00338 2E

## ON-SITE TESTS

A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator, W80-00057 4A

Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B

## ONTARIO (CANADA)

Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H

## OPEN CHANNEL FLOW

Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A

Interfacial Stability in Channel Flow, W80-00297 2E

## OPEN CHANNELS

Interfacial Stability in Channel Flow, W80-00297 2E

## OPERATION AND MAINTENANCE

Economic Return on Pollution Control Expenditures for the Pickled Food Industry, W80-00131 5D

## OPERATIONS

Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E

## OPTIMIZATION

Theory and Application of Environmental Economics, W80-00027 6A

Comment on 'Value of Information in Reservoir Optimization' by V. Klemes, W80-00147 6A

Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A

Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362 4B

Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F

## OREGON

A Comparison of Fluorescein Dye and Antibiotic-Resistant Escherichia Coli as Indicators of Pollution in Groundwater, W80-00145 2G

## ORGANIC COMPOUNDS

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D

Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase I, W80-00244 5D

Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B

## ORGANIC MATTER

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

## ORGANISM LENGTH

An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A

## ORGANOPHOSPHORUS PESTICIDES

Control of Salt Marsh Culicoides and Tabanus Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013 5C

## OUTER CONTINENTAL SHELF

Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C

A Fishery-Oil Spill Interaction Model, W80-00150 5C

Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154 5C

Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

Cold Regions Spill Response, W80-00158 5C

The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants, W80-00159 5C

Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160 5C

Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161 5C

Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162 5C

Ecological Impacts of Oil Spill Cleanup: Are They Significant, W80-00163 5C

A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164 5C

Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C

The Occurrence of 'White Eye Syndrome' in Shrimp (Penaeus Aztecus), W80-00166 5C

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C

The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

# SUBJECT INDEX

## PESTICIDES

- measuring the  
5C  
Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C
- el,  
5C  
Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipoda, W80-00171 5C
- se and Se  
the Amoco  
5C  
The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, *Rhithropanopeus Harrisi*, W80-00172 5C
- Spills from  
ties--Prelimi  
5C  
Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173 5B
- ottom Sedi-  
Site,  
5C  
Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, *Ilyanassa Obsoleta*, W80-00174 5C
- sses in the  
Co Cadiz Oil  
5C  
Hydrocarbons in Sediments from the Edge of the Bermuda Platform, W80-00175 5C
- Clean-Up at  
5C  
Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments, W80-00176 5C
- the Brazilian  
5C  
C15+Hydrocarbons in the Sediments of the New York Bight, W80-00177 5C
- esent Levels  
utants in the  
5B  
Petroleum Hydrocarbons in the North Sea, W80-00178 5C
- 5C  
Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C
- ines by the  
5C  
Selective Oil Spill Combat Planning for Off-shore Exploration and Production Operations in the North Sea, W80-00180 5C
- ersants at Sea  
5C  
Oil Spill Forecasting--Where Is It Going, W80-00181 5C
- Dispersion of  
5C  
A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C
- s to Oil Spill  
5C  
Effects of an Oil Slick on Wind Waves, W80-00183 5C
- Cleanup: Are  
5C  
Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C
- n Oil Spill in  
5C  
Oil Spill Treatment Strategy Modeling for Georges Bank, W80-00185 5C
- n Important  
Environment,  
5C  
Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186 5C
- ndrome' in  
5C  
Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187 5C
- ility to Tox-  
ane Effects,  
5C  
Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C
- e Species to  
il Oil,  
5C  
Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189 5C
- of Petroleum  
rine Ecosys-  
bility,  
5C  
The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C
- A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- OUTLETS  
Modernised System for Cape Town. W80-00259 5D
- OVERLAND FLOW  
The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L
- Sediment Yield Equation from an Erosion Simulation Model, W80-00280 2J
- OXIDATION  
Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D
- OXYGEN  
Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H
- Utilization of Oxygen Models in Environmental Impact Analysis, W80-00312 5C
- PACIFIC COAST REGION  
Beach and Salt Marsh Vegetation of the North American Pacific Coast, W80-00031 2I
- PALEOCLIMNOLOGY  
Use of Complex Paleogeographic Method to Recognize the History of Distrophic Lakes and High Bogs as Exemplified by an Interglacial Lake at Gorkow Near Warszawa, W80-00007 2H
- PARAMETRIC HYDROLOGY  
Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A
- PARTICLE SIZE  
Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J
- PASCO COUNTY (FLA)  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- PATENTS  
Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005 5G
- Process for Treatment of Sewage in a Gravity Sewer, W80-00008 5D
- Water Recovery Device, W80-00030 2A
- Method and Device for Determining the Pore Water Pressure in a Soil, W80-00110 2G
- PATH OF POLLUTANTS  
Oil Spill Forecasting--Where Is It Going, W80-00181 5C
- A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C
- The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C
- Monitoring of Subsurface Injection of Wastes, Florida, W80-00222 5B
- PEAK DISCHARGE  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- PEAT  
Minnesota Peat Program: Management Goals and Objectives and Policy Alternatives. W80-00316 6A
- Peatland Policy Study, W80-00317 6E
- PENNSYLVANIA  
Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B
- PENSACOLA (FL)  
Monitoring of Subsurface Injection of Wastes, Florida, W80-00222 5B
- PERFORMANCE  
Treatment of Packinghouse Wastewater by Sand Filtration, W80-00129 5D
- PERIPHYTE  
Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G
- PERMIT  
The Coastal Commissions and State Agencies: Conflict and Cooperation, W80-00365 6E
- PERMITS  
The Role of the Permit System in the California Coastal Strategy, W80-00364 6E
- PESTICIDE RESIDUES  
Adsorption and Accumulation of Pesticides Residues and Chlorinated Biphenyls in Both Wild Aquatic Vegetation and Rice in the Camargue Region, (In French), W80-00020 5B
- Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- PESTICIDE TOXICITY  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*, W80-00392 5C
- Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, *Ictalurus Punctatus*, W80-00395 5A
- PESTICIDES  
Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A
- Cost Benefits of Physical Chemical Treatment, W80-00113 5D
- Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C

# SUBJECT INDEX

## PESTICIDES

Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D

## PHENOLS

Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108 5D

Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D

## PHOSPHATE

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

## PHOSPHATES

Sewage Treatment - The State of the Art, W80-00261 5D

## PHOSPHORUS

Mathematical Modeling--Spartina, W80-00034 2I

Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory, W80-00208 2H

Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H

Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H

## PHYSICAL PROPERTIES

Soil Investigations: Richelieu Dam Project, St. John's Shoal, St. John, St. John's County, Quebec, W80-00042 8D

The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D

Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges, W80-00243 8G

## PHYSICOCHEMICAL PROPERTIES

2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Held at the Taft Center, Cincinnati, Ohio, November 12-14, 1975, W80-00097 5D

## PHYTOPLANKTON

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

The Uptake of <sup>226</sup>Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A

Accumulation of Cadmium by Dunaliella Tertiolecta Butcher, W80-00398 5A

Response of Lake Phytoplankton Communities to In Situ Manipulations of Light Intensity and Colour, W80-00400 5A

## PHYTOPLANKTON-DECOMPOSITION

### INTERACTIONS

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

## PILOT PLANTS

A Review of EPA's Urban Runoff Pollution Control Research Program, W80-00058 4A

Treatment of Packinghouse Wastewater by Sand Filtration, W80-00129 5D

An Effective Wastewater Management Program for a Food Processor, W80-00130 5D

## PIMA COUNTY

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C

## PITHLACHASCOTEE RIVER

Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E

## PLANKTON

Community Plankton Respiration in a Salt Marsh Estuary and the Importance of Macrophytic Leachates, W80-00014 2I

## PLANKTON PATCHINESS

Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H

## PLANNING

Wastewater Effluent-An Element of Total Water Resource Planning, W80-00284 3C

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C

Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E

## PLANT GROWTH

Nutrient Limitation in Salt Marsh Vegetation, W80-00039 2I

## PLANT MORPHOLOGY

A Review of Structure in Several North Carolina Salt Marsh Plants, W80-00032 2I

## PLANT PHYSIOLOGY

Water Relations of Three Mangrove Species in South Florida, W80-00009 2I

Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021 2I

Seasonal Patterns of CO<sub>2</sub> and Water Vapor Exchange of Juncus Roemerianus Scheele in a Georgia Salt Marsh, W80-00023 2I

## POLITICAL CONSTRAINTS

Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275 3B

The Quiet Before the Shootout Over 'The Water Law of the West', W80-00360 6E

## POLLUTANT IDENTIFICATION

Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975 and Denver, Colorado, December 2-4, 1975, W80-00043 4A

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

## POLLUTANTS

Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345 5A

## POLYCHLORINATED BIPHENYLS

Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A

Cost Benefits of Physical Chemical Treatment, W80-00113 5D

Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A

## POLYELECTROLYTES

Studies on Wastewater Treatment with Flocculants Application, W80-00099 5D

Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D

## POLYMERS

Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D

Immobilization of Hazardous Residuals by Encapsulation, W80-00256 5D

## PONDEROSA PINE TREES

Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A

## PONDS

Emergency Aeration of Fish Ponds, W80-00192 8I

Effectiveness of Sealing Southeastern Arizona Stock Ponds with Soda Ash, W80-00278 4A

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

## PORE PRESSURE

Method and Device for Determining the Pore Water Pressure in a Soil, W80-00110 2G

## PORE WATER

Method and Device for Determining the Pore Water Pressure in a Soil, W80-00110 2G

## POROUS MEDIA

The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow, W80-00090 2G

Diffusion of Dissolved Gas in Consolidating Porous Media, W80-00095 2F

## POTABLE WATER

The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water, W80-00263 5E

Richards Bay Mzingazi Water Purification Works, W80-00268 5F

# SUBJECT INDEX

## RAINFALL

- 5A The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C
- POTATOES  
Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D
- Potato Juice Processing, W80-00136 5D
- POTHOLES  
Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I
- POULTRY  
Water Reuse of Wastewater from a Poultry Processing Plant, W80-00142 5D
- Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143 5D
- POWERPLANTS  
Comparison of Finite Element and Finite Difference Methods in Thermal Discharge Investigations, W80-00082 5B
- PRAIRIE  
Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C
- PRECIPITATION (ATMOSPHERIC)  
Land Use and Urban Development Affecting Stormwater Pollution and Water Quality, W80-00047 4A
- PREDICTION  
Factors for Predicting Commercial Water Use, W80-00203 6D
- Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits, W80-00211 2H
- PREDICTOR  
Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A
- PRESERVATION  
Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E
- PRIMARY PRODUCTIVITY  
Primary Productivity of Emergent Macrophytes in a Wisconsin Marsh Ecosystem, W80-00026 2I
- Primary Productivity of Alpine Meadow Communities, W80-00324 2G
- The Contribution of Ammonia Excreted by Zooplankton to Phytoplankton Production in Narragansett Bay, W80-00399 5A
- PRINCIPAL COMPONENTS ANALYSIS  
Factors for Predicting Commercial Water Use, W80-00203 6D
- PRIOR APPROPRIATION  
Obtaining Access to Solar Energy: Nuisance, Water Rights, and Zoning Administration, W80-00382 6E
- PROBABILITY  
Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A
- PROCESS-LEVEL RESEARCH  
Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- PRODUCTIVITY  
An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I
- PROJECT PLANNING  
Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975 and Denver, Colorado, December 2-4, 1975. W80-00043 4A
- Considerations in Characterization of Urban Runoff for PL 92-500 Section 208 Planning, W80-00045 4A
- Instream Impacts of Urban Runoff, W80-00046 4A
- Runoff and Quality, W80-00050 4C
- Applications of Stormwater Management Models, W80-00051 4A
- Urban Stormwater Detention and Flow Attenuation for Pollution Control, W80-00059 4A
- Urban Stormwater Management Problems and Solutions-Overview of a Nationwide Study, W80-00060 4A
- Financing Storm Water Control Projects, W80-00065 4A
- Planning to Narrow the Implementation Gap, W80-00067 4A
- Implementation of Urban Stormwater Runoff Plans, W80-00068 4A
- PROJECT POST-EVALUATION  
Tucson's Tools for Demand Management, W80-00270 6B
- Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275 3B
- PROJECTS  
United States Geological Survey Yearbook, Fiscal Year 1978. W80-00236 7C
- PROTEIN  
Potato Juice Processing, W80-00136 5D
- PROTEINS  
Recovery of Soluble Serum Proteins from Meat Industry Wastes, W80-00132 5D
- Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D
- PUBLIC HEALTH  
Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G
- Virus Consideration in Land Disposal of Sewage Effluents and Sludge, W80-00306 5A
- PUBLICATIONS  
Considerations in Characterization of Urban Runoff for PL 92-500 Section 208 Planning, W80-00045 4A
- PULP AND PAPER INDUSTRY  
Stanger Pulp and Paper Mill - Clearing the Water. W80-00265 5D
- PUMPING  
Exact Aquitard Response Functions for Multiple Aquifer Mechanics, W80-00356 2F
- PYRITE  
Pyrite: Its Rapid Formation in a Salt Marsh and Its Importance to Ecosystem Metabolism, W80-00311 2K
- QUINCY BASIN (WA)  
Use of Digital Models to Manage Ground Water, W80-00252 2F
- RADAR  
Rainfall Measurement by Radar, W80-00329 7B
- A System for Real-Time Processing Transmission and Display of Radar-Derived Rainfall Data, W80-00330 7B
- Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B
- Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B
- Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B
- Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337 7B
- RADIOACTIVE WASTES  
Pressure Filters for Specialised Wastewater Treatment. W80-00264 5D
- RADIUM RADIOISOTOPES  
The Uptake of <sup>226</sup>Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A
- RAIN GAGES  
Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B
- Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B
- RAINFALL  
A Stochastic Kinematic Study of Subsynchronous Space-Time Rainfall, W80-00092 2B
- Rainfall Measurement by Radar, W80-00329 7B
- A System for Real-Time Processing Transmission and Display of Radar-Derived Rainfall Data, W80-00330 7B
- Installation and Operation of the Dee Telemetry System, W80-00332 7B
- Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

# SUBJECT INDEX

## RAINFALL

- Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B
- Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337 7B
- Ridge Regression--Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350 2B

## RAINFALL INTENSITY

- Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276 2E

## RAINFALL-RUNOFF RELATIONSHIPS

- Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276 2E
- Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G
- Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D
- Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290 3B

## RAINIER MESA

- Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K

## REAL PROPERTY

- Legal Aspects of Urban Stormwater Management, W80-00063 4A

## REAL TIME

- Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A

## REAL-TIME CONTROL

- Model for Selection of Stormwater Control Alternatives, W80-00318 6B

## RECHARGE

- Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362 4B

## RECIRCULATED WATER

- Treatment of Chemical Plant Effluents, W80-00101 5D
- Water Reuse in a Wet Process Hardboard Manufacturing Plant, W80-00250 5D

## RECLAIMED WATER

- The Economic Implications of Water Re-Use, W80-00257 5D
- Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

## RECYCLING

- An Effective Wastewater Management Program for a Food Processor, W80-00130 5D
- Reuse of Fermentation Brines in the Cucumber Pickling Industry, W80-00251 5D
- Aircraft Industry Wastewater Recycling, W80-00255 5D

- Current Technology and Research on Re-Use of Effluents, W80-00258 5D

- Modernised System for Cape Town, W80-00259 5D

- Stanger Pulp and Paper Mill - Clearing the Water, W80-00265 5D

## REGIME

- Alternative Regimes for the Ocean, W80-00377 6E

## REGIONAL ANALYSIS

- Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

## REGRESSION ANALYSIS

- Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224 7B
- Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292 2C

## REGULATION

- Status of EPA's Effluent Guidelines for the Food Industry, W80-00117 6E
- Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B
- Minnesota Peat Program: Management Goals and Objectives and Policy Alternatives, W80-00316 6A
- Peatland Policy Study, W80-00317 6E

## REMOTE SENSING

- Remote Sensing as a Tool for Studying the Ecology of Halophytes, W80-00037 7B
- Rainfall Measurement by Radar, W80-00329 7B
- A System for Real-Time Processing Transmission and Display of Radar-Derived Rainfall Data, W80-00330 7B

## REPLACEMENT COSTS

- Compensating States and the Federal Government for Damages to Natural Resources Resulting from Oil Spills, W80-00387 6E

## RESEARCH

- The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H

## RESEARCH AND DEVELOPMENT

- Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

## RESEARCH NEEDS

- Perspectives on Lake Ecosystem Modeling, W80-00204 2H

## RESEARCH PROGRAMS

- A Review of EPA's Urban Runoff Pollution Control Research Program, W80-00058 4A

## RESERVOIR DESIGN

- The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277 8A

## RESERVOIR OPERATION

- The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277 8A
- Control Rules for Long and Short Term Objectives, W80-00335 2E
- Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A
- Stochastic Optimization of a Water Supply System, W80-00397 6A

## RESERVOIR STORAGE

- The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277 8A

## RESERVOIRS

- Comment on 'Value of Information in Reservoir Optimization' by V. Klemes, W80-00147 6A
- Utilization of Oxygen Models in Environmental Impact Analysis, W80-00312 5C

## RESISTANCE

- Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I

## RESOURCES DEVELOPMENT

- Who Will Reap the Mineral Riches of the Deep, W80-00375 6E

## RESPIRATION

- Community Plankton Respiration in a Salt Marsh Estuary and the Importance of Macrophytic Leachates, W80-00014 2I

## REVIEWS

- Water Analysis, W80-00217 1A
- United States Geological Survey Yearbook, Fiscal Year 1978, W80-00236 7C
- Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C

## RHIZOMES

- Silica and Ash in the Salt Marsh Rush, Juncus Roemerianus, W80-00325 2I

## RIPARIAN RIGHTS

- Obtaining Access to Solar Energy: Nuisance, Water Rights, and Zoning Administration, W80-00382 6E

## RIVER BASIN DEVELOPMENT

- International Environmental Implications of Soviet Development of the Volga River, W80-00368 6E

## RIVER BASINS

- Use of Digital Models to Manage Ground Water, W80-00252 2F
- Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A

# SUBJECT INDEX

## SEDIMENT TRANSPORT

### RIVER DEE

Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B

Installation and Operation of the Dee Telemetry System, W80-00332 7B

Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

Control Rules for Long and Short Term Objectives, W80-00335 2E

Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B

### RIVER REGULATION

International Environmental Implications of Soviet Development of the Volga River, W80-00368 6E

### ROOT ZONES

Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones, W80-00309 2I

### ROOTED AQUATIC PLANTS

An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I

### RUNOFF

Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D

Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

### RUNOFF COEFFICIENT

Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276 2E

### RUNOFF FORECASTING

Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G

### SACRAMENTO RIVER

Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G

### SALICORNIA

Comparative Ecological Requirements of a Perennial and an Annual Salicornia Species: Germination and Growth During the Early Stages of Development, (In French), W80-00010 2I

Growth and Salt Accumulation in Two Annual Species of Salicornia from the Mediterranean Coast, (In French), W80-00018 2I

### SALINAS VALLEY (CA)

Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, W80-00238 2A

### SALMON

Salmon Processing Wastewater Treatment, W80-00140 5D

### SALT MARSH

Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303 2I

Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones, W80-00309 2I

### SALT MARSHES

Surficial Sediments of Saldanha Bay and Langebaan Lagoon, W80-00012 2J

Control of Salt Marsh Culicoides and Tabanus Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013 5C

Community Plankton Respiration in a Salt Marsh Estuary and the Importance of Macrophytic Leachates, W80-00014 2I

Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments, W80-00016 2I

An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I

Seasonal Patterns of CO<sub>2</sub> and Water Vapor Exchange of Juncus Roemerianus Scheele in a Georgia Salt Marsh, W80-00023 2I

Effects of Ground Applications of Malathion on Saltmarsh Environments in Northwestern Florida, W80-00025 5C

The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L

Relationship of Vertebrates to Salt Marsh Plants, W80-00038 2I

Nutrient Limitation in Salt Marsh Vegetation, W80-00039 2I

Pyrite: Its Rapid Formation in a Salt Marsh and Its Importance to Ecosystem Metabolism, W80-00311 2K

Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I

The Relationship of Marine Macroinvertebrates to Salt Marsh Plants, W80-00321 2I

Denitrification in a Salt Marsh Ecosystem, W80-00355 2L

### SALT TOLERANCE

Growth and Salt Accumulation in Two Annual Species of Salicornia from the Mediterranean Coast, (In French), W80-00018 2I

The Influence of Salinity, Inundation and Temperature on the Germination of Some Halophytes and Non-Halophytes, W80-00022 2I

Salt Tolerance of Mangroves and Submerged Aquatic Plants, W80-00033 2I

Halophyte Seed Germination, W80-00326 2I

### SALTS

Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

### SAMPLING

Systematic Sampling of Gaussian Random Processes and Fields, W80-00089 2F

Petroleum Hydrocarbons in the North Sea, W80-00178 5C

A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A

Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J

Fishery Survey of Cedar Lakes and the Brazos and San Bernard River Estuaries, W80-00305 2H

### SANTA YNEZ RIVER (CA)

Real-Time Flood Forecasting for Southern California, W80-00340 2E

### SATURATED FLOW

The Significance of the Storage Parameter in Saturated-Unsaturated Groundwater Flow, W80-00094 2F

### SCALING

Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005 5G

Corrosion and Scale-Formation Properties of Geopressed Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A

### SCREENS

Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D

### SEA ICE

A Dynamic Thermodynamic Sea Ice Model, W80-00084 2C

### SEA OF CRETE

Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B

### SEASONAL

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

### SEDIMENT TRANSPORT

Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J

# SUBJECT INDEX

## SEDIMENT YIELD

### SEDIMENT YIELD

Sediment Yield Equation from an Erosion Simulation Model,  
W80-00280 2J

### SEDIMENTATION

Land Management Techniques for Developing Areas,  
W80-00053 4D

SCS Practices as Related to Sediment and Erosion Control,  
W80-00054 4D

### SEDIMENTATION RATES

Sediment Yield Equation from an Erosion Simulation Model,  
W80-00280 2J

### SEDIMENTS

Surficial Sediments of Saldanha Bay and Langebaan Lagoon,  
W80-00012 2J

Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments,  
W80-00016 2I

The Fluvial System: Selected Observations,  
W80-00019 2E

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron,  
W80-00088 2K

Behavior and Effectiveness of Dispersants at Sea and at Shorelines,  
W80-00160 5C

Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods,  
W80-00171 5C

Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California,  
W80-00173 5B

Hydrocarbons in Sediments from the Edge of the Bermuda Platform,  
W80-00175 5C

Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments,  
W80-00176 5C

Cl5+Hydrocarbons in the Sediments of the New York Bight,  
W80-00177 5C

Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord,  
W80-00179 5C

Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II,  
W80-00186 5C

Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario,  
W80-00341 5A

### SEEDS

Halophyte Seed Germination,  
W80-00326 2I

### SEEPAGE

Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake,  
W80-00358 5B

### SEEPAGE CONTROL

Effectiveness of Sealing Southeastern Arizona Stock Ponds with Soda Ash,  
W80-00278 4A

### SEPARATION TECHNIQUES

Treatment of Concentrated Waste Waters Containing Oil Emulsions,  
W80-00111 5D

Methods for Separation of Sediment from Storm Water at Construction Sites,  
W80-00247 5D

### SEQUENTIAL PROCEDURE

Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management,  
W80-00361 6A

### SETTLING BASINS

Treatment of Concentrated Waste Waters Containing Oil Emulsions,  
W80-00111 5D

Operation and Control of Water Purification Plants, Part II,  
W80-00262 5E

### SEWAGE EFFLUENTS

Virus Consideration in Land Disposal of Sewage Effluents and Sludge,  
W80-00306 5A

### SEWAGE SLUDGE

Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties,  
W80-00115 5D

Virus Consideration in Land Disposal of Sewage Effluents and Sludge,  
W80-00306 5A

### SEWAGE TREATMENT

Process for Treatment of Sewage in a Gravity Sewer,  
W80-00008 5D

Studies on Wastewater Treatment with Flocculants Application,  
W80-00099 5D

Treatment of Chemical Plant Effluents,  
W80-00101 5D

Current Technology and Research on Re-Use of Effluents,  
W80-00258 5D

Sewage Treatment - The State of the Art,  
W80-00261 5D

Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area,  
W80-00272 5D

### SEWERAGE

Cost Effective Approach for Combined Storm and Sewer Clean-Up,  
W80-00055 4A

Collection System Control,  
W80-00056 4A

A Review of EPA's Urban Runoff Pollution Control Research Program.  
W80-00058 4A

### SHALLOW WATER

The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands,  
W80-00349 2D

### SHEEP

Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep,  
W80-00299 2I

### SHORE PROTECTION

The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants,  
W80-00159 5C

Local Government Response to State-Mandated Land Use Laws,  
W80-00369 6E

### SHORES

Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan,  
W80-00348 2J

### SHRIMP

Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry,  
W80-00137 5D

The Occurrence of 'White Eye Syndrome' in Shrimp (*Penaeus aztecus*),  
W80-00166 5C

### SILICA

Silica and Ash in the Salt Marsh Rush, *Juncus roemerianus*,  
W80-00325 2I

### SIMULATION ANALYSIS

Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige),  
W80-00072 2C

Perspectives on Lake Ecosystem Modeling.  
W80-00204 2H

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review,  
W80-00206 2H

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration,  
W80-00207 2H

Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory,  
W80-00208 2H

Modifications to the Model Cleaner Requiring Further Research,  
W80-00209 2H

Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty,  
W80-00212 2H

Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model,  
W80-00214 2H

The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model,  
W80-00215 2H

An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model,  
W80-00216 5A

Sediment Yield Equation from an Erosion Simulation Model,  
W80-00280 2J

Model for Selection of Stormwater Control Alternatives,  
W80-00318 6B

### SKELETONEMA

The Contribution of Ammonia Excreted by Zooplankton to Phytoplankton Production in Narragansett Bay,  
W80-00399 5A

### SLUDGE TREATMENT

Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment,  
W80-00114 5D

# SUBJECT INDEX

## STORAGE

- Mandated  
6E
- on Later-  
ate Along  
2J
- ic Wastes  
Industry,  
5D
- ndrome' in  
5C
- ah, Juncus  
2I
- tribution of  
Y (Effet du  
es Surfaces  
ge),  
2C
- deling.  
2H
- osition of  
d Modeling  
2H
- Models: The  
2H
- rus Dynam-  
ental Work  
2H
- r Requiring  
2H
- orus: Devel-  
and Uncer-  
2H
- Dimensional  
2H
- roperties of  
n Ecological  
2H
- ario Using a  
5A
- rosion Simu-  
2I
- Control Al-  
6B
- Excreted by  
roduction in  
5A
- of Industrial  
ts Treatment,  
5D
- Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties, W80-00115 5D
- Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E
- Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges, W80-00243 8G
- SNOW**  
Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C
- SNOW MANAGEMENT**  
Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292 2C
- SNOWMELT**  
Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C
- Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H
- Comparing Water Supply Forecast Techniques, W80-00202 2A
- Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292 2C
- SOCIAL ASPECTS**  
Land Management Techniques for Stormwater Control in Developed Urban Areas, W80-00052 4C
- Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C
- SOIL CLASSIFICATIONS**  
Marsh Soils of the Atlantic Coast, W80-00320 2G
- SOIL COMPACTION**  
Diffusion of Dissolved Gas in Consolidating Porous Media, W80-00095 2F
- SOIL EROSION**  
Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D
- SOIL GASES**  
Diffusion of Dissolved Gas in Consolidating Porous Media, W80-00095 2F
- SOIL MOISTURE**  
Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- SOIL SEALANTS**  
Effectiveness of Sealing Southeastern Arizona Stock Ponds with Soda Ash, W80-00278 4A
- SOIL SURFACES**  
A Microroughness Meter for Evaluating Rain-water Infiltration, W80-00291 2G
- SOIL TYPES**  
Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B
- SOIL WATER MOVEMENT**  
A Comparison of Fluorescein Dye and Antibiotic-Resistant *Escherichia Coli* as Indicators of Pollution in Groundwater, W80-00145 2G
- Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G
- A Microroughness Meter for Evaluating Rain-water Infiltration, W80-00291 2G
- Substrate Conditions, Community Structure and Succession in a Portion of the Floodplain of Wissahickon Creek, W80-00310 2B
- SOILS**  
Soil Investigations: Richelieu Dam Project, St. John's Shoal, St. John, St. John's County, Quebec, W80-00042 8D
- SOLAR RADIATION**  
Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292 2C
- Obtaining Access to Solar Energy: Nuisance, Water Rights, and Zoning Administration, W80-00382 6E
- SOOES RIVER (WA)**  
Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I
- SORPTION**  
Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K
- SOUTH AFRICA**  
Surficial Sediments of Saldanha Bay and Langebaan Lagoon, W80-00012 2J
- SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT**  
Freshwater and the Florida Coast: Southwest Florida, W80-00367 6E
- SPATIAL DISTRIBUTION**  
A Stochastic Kinematic Study of Subsynchronous Space-Time Rainfall, W80-00092 2B
- SPATIAL-TEMPORAL SCALES**  
Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H
- SPATIAL VARIATIONS**  
Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A
- SPECTROMETERS**  
An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B
- SPRAYING**  
The Removal of Volatile Suspended Solids from Wastewaters, W80-00103 5D
- SPRINGS**  
Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226 2F
- Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A
- STABILITY**  
Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period, W80-00313 2H
- STABILIZATION**  
The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144 5D
- STANDARDS**  
The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144 5D
- Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A
- STANDING CROP**  
Primary Productivity of Alpine Meadow Communities, W80-00324 2G
- STANDING CROP PRODUCTIVITY**  
Factors Influencing Shoot Production and Mineral Nutrient Levels in *Typha Latifolia*, W80-00308 2I
- STATISTICAL METHODS**  
Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H
- A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- A Water Quality Economic Index, W80-00346 6B
- STEADY FLOW**  
Stochastic Analysis of Steady State Groundwater Flow in a Bounded Domain 1. One-Dimensional Simulations, W80-00070 2F
- STEEL**  
Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment, W80-00114 5D
- STOCHASTIC PROCESSES**  
A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A
- Stochastic Optimization of a Water Supply System, W80-00397 6A
- STORAGE**  
Best Management Practices, W80-00044 4A
- Collection System Control, W80-00056 4A
- Urban Stormwater Detention and Flow Attenuation for Pollution Control, W80-00059 4A
- Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H

## STORAGE COEFFICIENT

### STORAGE COEFFICIENT

The Significance of the Storage Parameter in Saturated-Unsaturated Groundwater Flow, W80-00094 2F

### STORM DRAINS

Legal Aspects of Urban Storm Water Management and Related Pollution Abatement Problems, W80-00064 4A

### STORM RUNOFF

Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975 and Denver, Colorado, December 2-4, 1975. W80-00043 4A

Land Management Techniques for Developing Areas, W80-00053 4D

A Review of EPA's Urban Runoff Pollution Control Research Program. W80-00058 4A

Urban Stormwater Detention and Flow Attenuation for Pollution Control, W80-00059 4A

Urban Stormwater Management Problems and Solutions-Overview of a Nationwide Study, W80-00060 4A

Legal Aspects of Urban Stormwater Management, W80-00063 4A

Legal Aspects of Urban Storm Water Management and Related Pollution Abatement Problems, W80-00064 4A

Financing Storm Water Control Projects, W80-00065 4A

Financing Stormwater Projects, W80-00066 4A

Planning to Narrow the Implementation Gap, W80-00067 4A

Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276 2E

Model for Selection of Stormwater Control Alternatives, W80-00318 6B

### STORM WATER

Best Management Practices, W80-00044 4A

Instream Impacts of Urban Runoff, W80-00046 4A

Land Use and Urban Development Affecting Stormwater Pollution and Water Quality, W80-00047 4A

Non-Point Source Impact and Urban Holding Capacity, W80-00049 4C

Runoff and Quality, W80-00050 4C

Applications of Stormwater Management Models, W80-00051 4A

Land Management Techniques for Stormwater Control in Developed Urban Areas, W80-00052 4C

Cost Effective Approach for Combined Storm and Sewer Clean-Up, W80-00055 4A

Urban Stormwater Detention and Flow Attenuation for Pollution Control, W80-00059 4A

The Intergovernmental Tangle Facing Stormwater Control, W80-00061 4D

State/Local Interaction in Stormwater Management, W80-00062 4A

Legal Aspects of Urban Stormwater Management, W80-00063 4A

Implementation of Urban Stormwater Runoff Plans, W80-00068 4A

Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers, W80-00246 5D

### STRAITS OF SICILY

Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B

### STREAM EROSION

Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289 2J

### STREAM GAGES

Surface Water Data Manitoba 1978. W80-00195 4A

Surface Water Data Yukon and Northwest Territories 1978. W80-00196 4A

### STREAM IMPROVEMENT

Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G

Stream Channel Modification in Hawaii. Part B: Effect of Channelization on the Distribution and Abundance of Fauna in Selected Streams, W80-00004 6G

### STREAMS

The Fluvial System: Selected Observations, W80-00019 2E

Velocity Profiles and Minimum Stream Power, W80-00077 2E

Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218 1A

Acidification of Headwater Streams in the New Jersey Pine Barrens, W80-00354 5B

### STRIP MINE WASTES

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

### STRUCTURAL ANALYSIS

Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224 7B

### SUBMERGED AQUATIC PLANTS

Salt Tolerance of Mangroves and Submerged Aquatic Plants, W80-00033 2I

### SUBSIDENCE

Controls and Remedies for Ground Water - Caused Land Subsidence, W80-00389 6E

### SURFACE RUNOFF

SCS Practices as Related to Sediment and Erosion Control, W80-00054 4D

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290 3B

### SURFACE WATER AVAILABILITY

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

### SURFACE WATERS

Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic, W80-00194 5C

Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C

Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A

Water Resources Data for Nebraska, Water Year 1978. W80-00234 7C

Water Resources Data for Alabama, Water Year 1978. W80-00235 7C

Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C

Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345 5A

### SURFACES

The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D

### SURVEYS

Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B

### SUSPENDED SOLIDS

Cost Effective Approach for Combined Storm and Sewer Clean-Up, W80-00055 4A

Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D

Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D

Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E

An Effective Wastewater Management Program for a Food Processor, W80-00130 5D

### SUSPENSION

Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J

### SWAMPS

Factors Influencing Shoot Production and Mineral Nutrient Levels in Typha Latifolia, W80-00308 2I

# SUBJECT INDEX

## TRICKLING FILTERS

- and Ero-  
4D
- Household  
3D
- Mountain  
3B
- Household  
3D
- y, Vol. 1  
C, 5C
- f Western  
5C
- ern Arctic  
1A
- ta, Water  
7C
- Water Year  
7C
- er Water-  
7C
- precipitation  
and Statisti-  
5A
- Physico-  
5D
- e Eastern  
5B
- ned Storm  
4A
- algae from  
Proposed  
5D
- eatment of  
5D
- Sludge Di-  
try, 5E
- at Program  
5D
- Fine Sedi-  
2J
- n and Min-  
a, 2I
- SWEET CORN**  
Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E
- Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D
- Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D
- SYSTEMS ANALYSIS**  
Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- TALLAHALA CREEK (MS)**  
Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A
- TAR**  
Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173 5B
- TELEMETRY**  
Installation and Operation of the Dee Telemetry System, W80-00332 7B
- Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B
- A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- TEMPERATURE**  
Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H
- TEMPORAL DISTRIBUTION**  
A Stochastic Kinematic Study of Subsynoptic Space-Time Rainfall, W80-00092 2B
- TERTIARY TREATMENT**  
The Operation of the Physical-Chemical Plant at Rosemount, Minnesota, W80-00100 5D
- Sewage Treatment - The State of the Art, W80-00261 5D
- TESTING**  
A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- TEXAS**  
Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F
- Controls and Remedies for Ground Water - Caused Land Subsidence, W80-00389 6E
- THE NETHERLANDS**  
The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349 2D
- THEORETICAL ANALYSIS**  
Systematic Sampling of Gaussian Random Processes and Fields, W80-00089 2F
- THERMAL CONDUCTIVITY**  
Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- THERMAL POLLUTION**  
Comparison of Finite Element and Finite Difference Methods in Thermal Discharge Investigations, W80-00082 5B
- THERMAL PROPERTIES**  
Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351 2D
- THERMAL SKIN**  
Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351 2D
- THERMAL WATER**  
Corrosion and Scale-Formation Properties of Geopressured Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A
- TIDAL EFFECTS**  
A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- TIDES**  
On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079 2L
- TISSUE ANALYSIS**  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*, W80-00392 5C
- The Uptake of 226Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A
- Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, *Ictalurus Punctatus*, W80-00395 5A
- Effect of Distillery Waste on Some Freshwater Teleosts-Biochemical Studies, W80-00396 5B
- TOXICITY**  
Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D
- Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C
- Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic, W80-00194 5C
- Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C
- TRACE ELEMENTS**  
Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B
- Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C
- TRACERS**  
Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F
- A Comparison of Fluorescein Dye and Antibiotic-Resistant *Escherichia Coli* as Indicators of Pollution in Groundwater, W80-00145 2G
- TRANSMISSIVITY**  
A Direct Solution to the Inverse Problem in Groundwater Flow, W80-00081 2F
- TREATMENT**  
2nd USA/USSR Symposium on Physical/Chemical Treatment from Municipal and Industrial Sources, Held at the Taft Center, Cincinnati, Ohio, November 12-14, 1975. W80-00097 5D
- Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A
- TREATMENT FACILITIES**  
A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator, W80-00057 4A
- The Operation of the Physical-Chemical Plant at Rosemount, Minnesota, W80-00100 5D
- Design of Facilities for Physical-Chemical Treatment of Raw Wastewater, W80-00104 5D
- Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers, W80-00246 5D
- Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, W80-00253 5D
- Modernised System for Cape Town. W80-00259 5D
- The Pumping of Water from Mines in the Central Witwatersrand, W80-00260 5D
- Roodepoort Now Handles Own Wastewater, W80-00267 5D
- TREES**  
Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041 2I
- TREND DETECTION**  
A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- TRICHLOROFLUOROMETHANE**  
Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F
- TRICKLE IRRIGATION**  
Trickle Irrigation: Prevention of Clogging, W80-00074 5F
- TRICKLING FILTERS**  
Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F

# SUBJECT INDEX

## TRITIUM

### TRITIUM

Tritium and Oxygen Profiles in the Eastern Mediterranean,  
W80-00078 5B

### TROPICAL REGIONS

Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site,  
W80-00188 5C

### TURBULENCE

Bubble Populations and Spectra in Coastal Waters: A Photographic Approach,  
W80-00352 2L

### TURF GRASSES

Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter,  
W80-00274 5F

### UNCERTAINTY

Comment on 'Value of Information in Reservoir Optimization' by V. Klemes,  
W80-00147 6A

### UNDERGROUND WASTE DISPOSAL

Monitoring of Subsurface Injection of Wastes, Florida,  
W80-00222 5B

### UNSATURATED FLOW

The Significance of the Storage Parameter in Saturated-Unsaturated Groundwater Flow,  
W80-00094 2F

### URBAN HYDROLOGY

Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona,  
W80-00269 4B

Arizona Groundwater Law Reform - An Urban Perspective,  
W80-00271 6E

Legal Aspects of Urban Runoff Development,  
W80-00293 6E

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona,  
W80-00294 5C

### URBAN RUNOFF

Best Management Practices,  
W80-00044 4A

Considerations in Characterization of Urban Runoff for PL 92-500 Section 208 Planning,  
W80-00045 4A

Instream Impacts of Urban Runoff,  
W80-00046 4A

Land Use and Urban Development Affecting Stormwater Pollution and Water Quality,  
W80-00047 4A

Impact of CSO/SSD on Water Quality,  
W80-00048 4A

Non-Point Source Impact and Urban Holding Capacity,  
W80-00049 4C

Runoff and Quality,  
W80-00050 4C

Land Management Techniques for Stormwater Control in Developed Urban Areas,  
W80-00052 4C

Cost Effective Approach for Combined Storm and Sewer Clean-Up,  
W80-00055 4A

Collection System Control,  
W80-00056 4A

A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator,  
W80-00057 4A

Urban Stormwater Management Problems and Solutions-Overview of a Nationwide Study,  
W80-00060 4A

The Intergovernmental Tangle Facing Stormwater Control,  
W80-00061 4D

State/Local Interaction in Stormwater Management,  
W80-00062 4A

Legal Aspects of Urban Stormwater Management,  
W80-00063 4A

Legal Aspects of Urban Storm Water Management and Related Pollution Abatement Problems,  
W80-00064 4A

Financing Stormwater Projects,  
W80-00066 4A

Planning to Narrow the Implementation Gap,  
W80-00067 4A

Implementation of Urban Stormwater Runoff Plans,  
W80-00068 4A

Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers,  
W80-00246 5D

Legal Aspects of Urban Runoff Development,  
W80-00293 6E

Contribution of Urban Runoff to Hydrocarbon Pollution,  
W80-00357 5B

### US GEOLOGICAL SURVEY

United States Geological Survey. Yearbook, Fiscal Year 1978.  
W80-00236 7C

### UTAH

Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979,  
W80-00230 2F

### VALUE

The Potential Economic Uses of Halophytes,  
W80-00040 6C

Comment on 'Value of Information in Reservoir Optimization' by V. Klemes,  
W80-00147 6A

The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model,  
W80-00215 2H

### VARIABILITY

Assessment of Water Quality Simulation Capability for Lake Ontario,  
W80-00199 2A

### VEGETABLE CROPS

Effluent Generation, Energy Use and Cost of Blanching,  
W80-00122 5D

Reuse of Brines in Commercial Cucumber Fermentations,  
W80-00128 5D

### VEGETATION

Contribution to the Study of Some Bryoassociations of the Subalpine Zone in the Southeast of France (Contribution a l'etude de Quelques Bryoassociations de l'etage Subalpine Dans le Sud-est de la France),  
W80-00006 2I

Seasonal Patterns of CO2 and Water Vapor Exchange of Juncus Roemerianus Scheele in a Georgia Salt Marsh,  
W80-00023 2I

Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period,  
W80-00313 2H

### VEGETATION CHANGES

Modeling Management of Ponderosa Pine Forest Resources,  
W80-00228 2A

### VELOCITY

Velocity Profiles and Minimum Stream Power,  
W80-00077 2E

### VENICE (ITALY)

On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea,  
W80-00079 2L

### VERTICAL MIGRATION

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration,  
W80-00207 2H

### VIRGINIA

State/Local Interaction in Stormwater Management,  
W80-00062 4A

### VIRUSES

Virus Consideration in Land Disposal of Sewage Effluents and Sludge,  
W80-00306 5A

### VISCOSITY

Velocity Profiles and Minimum Stream Power,  
W80-00077 2E

### VOLATILITY

The Removal of Volatile Suspended Solids from Wastewaters,  
W80-00103 5D

### WALES

Installation and Operation of the Dee Telemetry System,  
W80-00332 7B

Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project,  
W80-00333 7B

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee,  
W80-00334 2E

Control Rules for Long and Short Term Objectives,  
W80-00335 2E

Rainfall Forecasts in the United Kingdom Using Radar Data,  
W80-00336 2B

### WASHINGTON PARISH (LA)

Ground-Water Resources of Washington Parish, Louisiana,  
W80-00227 2F

### WASTE DISPOSAL

Information About Hazardous Waste Management Facilities,  
W80-00245 5D

Immobilization of Hazardous Residuals by Encapsulation,  
W80-00256 5D

Pressure Filters for Specialised Wastewater Treatment,  
W80-00264 5D

# SUBJECT INDEX

## WATER POLLUTION EFFECTS

### WASTE TREATMENT

Proceedings of the 8th National Symposium on Food Processing Wastes, March 30-April 1, 1977, Seattle, Washington.  
W80-00116 5D

Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry, W80-00137 5D

Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B

Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D

### WASTE WATER TREATMENT

Process for Treatment of Sewage in a Gravity Sewer, W80-00008 5D

Collection System Control, W80-00056 4A

Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D

Current Technology and Research on Re-Use of Effluents, W80-00258 5D

Botanical Control: Purifying Industrial Wastewater, W80-00266 5D

Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272 5D

Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D

Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F

Wastewater Reuse-How Viable Is It. Another Look, W80-00283 5F

Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

### WASTEWATER DISPOSAL

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

### WATER ALLOCATION

The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C

### WATER ALLOCATION (POLICY)

Tucson's Tools for Demand Management, W80-00270 6B

### WATER ANALYSIS

Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B

An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B

### WATER BUDGET

Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona, W80-00269 4B

### WATER CHEMISTRY

Corrosion and Scale-Formation Properties of Geopressed Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A

Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A

### WATER CONSERVATION

Water Conservation and Alternative Water Supplies, Proceedings of a Southeast Regional Conference November 8-9, 1978 at the Georgia Institute of Technology, W80-00001 6D

Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

### WATER DEMAND

Factors for Predicting Commercial Water Use, W80-00203 6D

Tucson's Tools for Demand Management, W80-00270 6B

### WATER HARVESTING

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290 3B

### WATER HYACINTH

Botanical Control: Purifying Industrial Wastewater, W80-00266 5D

Weed Control Methods for River Basin Management, W80-00323 2I

### WATER LAW

Arizona Groundwater Law Reform - An Urban Perspective, W80-00271 6E

Legal Aspects of Urban Runoff Development, W80-00293 6E

### WATER LEVEL FLUCTUATIONS

Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979, W80-00230 2F

### WATER LEVELS

On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079 2L

Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H

Surface Water Data Manitoba 1978, W80-00195 4A

Surface Water Data Yukon and Northwest Territories 1978, W80-00196 4A

Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977, W80-00239 7C

Effects of a Drawdown on a Waterfowl Impoundment, W80-00315 2H

Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B

Installation and Operation of the Dee Telemetry System, W80-00332 7B

### WATER LOSS

Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289 2J

### WATER MANAGEMENT (APPLIED)

Arizona Groundwater Law Reform - An Urban Perspective, W80-00271 6E

Management Alternatives for Santa Cruz Basin Groundwater, W80-00296 6A

Freshwater and the Florida Coast: Southwest Florida, W80-00367 6E

Planning for Environmental Management: New Directions and Initiatives, W80-00386 6E

Controls and Remedies for Ground Water - Caused Land Subsidence, W80-00389 6E

### WATER POLICY

Use of Digital Models to Manage Ground Water, W80-00252 2F

Stochastic Optimization of a Water Supply System, W80-00397 6A

### WATER POLLUTION CONTROL

Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161 5C

Model for Selection of Stormwater Control Alternatives, W80-00318 6B

Report to the Congress on Ocean Pollution Over Fishing, and Offshore Development (October 1976 Through September 1977), W80-00381 6E

### WATER POLLUTION EFFECTS

A Fishery-Oil Spill Interaction Model, W80-00150 5C

Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities-Preliminary Results, W80-00152 5C

Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

Cold Regions Spill Response, W80-00158 5C

# SUBJECT INDEX

## WATER POLLUTION EFFECTS

The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants, W80-00159 5C

Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160 5C

Ecological Impacts of Oil Spill Cleanup: Are They Significant, W80-00163 5C

A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164 5C

Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C

The Occurrence of 'White Eye Syndrome' in Shrimp (*Penaeus Aztecus*), W80-00166 5C

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C

The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C

Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C

The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, *Rhithropanopeus Harrisi*, W80-00172 5C

Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, *Ilyanassa Obsoleta*, W80-00174 5C

Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments, W80-00176 5C

C15+ Hydrocarbons in the Sediments of the New York Bight, W80-00177 5C

Selective Oil Spill Combat Planning for Off-shore Exploration and Production Operations in the North Sea, W80-00180 5C

Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187 5C

Heavy Metals and Wastewater Reuse, W80-00282 5B

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C

## WATER POLLUTION SOURCES

Best Management Practices, W80-00044 4A

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

Information About Hazardous Waste Management Facilities, W80-00245 5D

Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D

Sediment Yield Equation from an Erosion Simulation Model, W80-00280 2J

The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345 5A

Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B

## WATER POLLUTION TREATMENT

Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D

Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F

## WATER PRESSURE

Pressure Filters for Specialised Wastewater Treatment, W80-00264 5D

## WATER PURIFICATION

Operation and Control of Water Purification Plants, Part II, W80-00262 5E

The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water, W80-00263 5E

Richards Bay Mzingazi Water Purification Works, W80-00268 5F

## WATER QUALITY

Runoff and Quality, W80-00050 4C

Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H

Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B

Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic, W80-00194 5C

Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A

Perspectives on Lake Ecosystem Modeling, W80-00204 2H

Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits, W80-00211 2H

A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A

Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H

An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A

Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G

Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226 2F

Ground-Water Resources of Washington Parish, Louisiana, W80-00227 2F

Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K

Water Resources Data for Nebraska, Water Year 1978, W80-00234 7C

Water Resources Data for Alabama, Water Year 1978, W80-00235 7C

Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977, W80-00239 7C

Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C

Ephemeral Flow and Water Quality Problems: A Case Study of the San Pedro River in Southeastern Ariz., W80-00281 2E

The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C

Formulation and Testing of a New Water Quality Index, W80-00304 7B

Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A

A Water Quality Economic Index, W80-00346 6B

BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353 5D

# SUBJECT INDEX

## WAVES (WATER)

ide to Water	2A	Water Quality Management Accomplishments Compendium I. W80-00242	6E	Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294	5C	Air and Water Pollution Policy, W80-00380	6E	Planning for Environmental Management: New Directions and Initiatives, W80-00386	6E	Water Quality Standards	2A	Air and Water Pollution Policy, W80-00380	6E	Water Re-Use	6E	Water Resources	1A	Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240	7C	Water Resources Development	3B	Management Alternatives for Santa Cruz Basin Groundwater, W80-00296	6A	Water Resources Planning	5F	Water Reuse	6E	Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118	5D	Reuse of Brines in Commercial Cucumber Fermentations, W80-00128	5D	Water Reuse of Wastewater from a Poultry Processing Plant, W80-00142	5D	Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143	5D	The Economic Implications of Water Re-Use, W80-00257	5D	Heavy Metals and Wastewater Reuse, W80-00282	5B	Wastewater Reuse-How Viable Is It. Another Look, W80-00283	5F	Wastewater Effluent-An Element of Total Water Resource Planning, W80-00284	3C	Salvaging Wasted Waters for Desert-Household Gardening, W80-00285	3D	Water Rights	6E	Response to GAO Water Report. W80-00372	6E	NCAI to GAO: Legislative Quantification of Indian Water Rights Is Not the Answer. W80-00373	6E	NCAI's Executive Council Meeting and Indian Water Rights. W80-00374	6E	Water Rights: The Issue and the Courts, W80-00376	6E	Water Sources	2E	Ephemeral Flow and Water Quality Problems: A Case Study of the San Pedro River in Southeastern Ariz., W80-00281	2E	Water Storage	8A	The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277	8A	Water Supply	6D	Water Conservation and Alternative Water Supplies, Proceedings of a Southeast Regional Conference November 8-9, 1978 at the Georgia Institute of Technology. W80-00001	6D	Comparing Water Supply Forecast Techniques, W80-00202	2A	Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona, W80-00269	4B	Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295	3F	Stochastic Optimization of a Water Supply System, W80-00397	6A	Water Temperature	5B	Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake, W80-00358	5B	Water Treatment	5D	The Pumping of Water from Mines in the Central Witwatersrand, W80-00260	5D	Water Utilization	6D	Factors for Predicting Commercial Water Use, W80-00203	6D	Ground-Water Resources of Washington Parish, Louisiana, W80-00227	2F	Water Vapor	2A	Water Recovery Device, W80-00030	2A	Water Wells	2F	Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226	2F	Ground-Water Resources of Washington Parish, Louisiana, W80-00227	2F	Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona, W80-00269	4B	Water Yield	2C	Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072	2C	Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226	2F	Modeling Management of Ponderosa Pine Forest Resources, W80-00228	2A	Water Yield Improvement	3B	Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275	3B	Waterfowl	2H	Effects of a Drawdown on a Waterfowl Impoundment, W80-00315	2H	Watershed Management	4A	Proceedings, Urban Stormwater Management Seminars, Atlanta, Georgia, November 4-6, 1975 and Denver, Colorado, December 2-4, 1975. W80-00043	4A	Land Management Techniques for Developing Areas, W80-00053	4D	SCS Practices as Related to Sediment and Erosion Control, W80-00054	4D	A Review of EPA's Urban Runoff Pollution Control Research Program. W80-00058	4A	Urban Stormwater Management Problems and Solutions-Overview of a Nationwide Study, W80-00060	4A	The Intergovernmental Tangle Facing Stormwater Control, W80-00061	4D	Financing Storm Water Control Projects, W80-00065	4A	Financing Stormwater Projects, W80-00066	4A	Implementation of Urban Stormwater Runoff Plans, W80-00068	4A	Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275	3B	Watersheds (Basins)	5C	Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254	5C	Waves (Water)	2L	Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank, W80-00085	2L	Effects of an Oil Slick on Wind Waves, W80-00183	5C	Bubble Populations and Spectra in Coastal Waters: A Photographic Approach, W80-00352	2L
--------------	----	--	----	---	----	---	----	--	----	-------------------------	----	---	----	--------------	----	-----------------	----	--	----	-----------------------------	----	---	----	--------------------------	----	-------------	----	---	----	---	----	--	----	---	----	--	----	--	----	--	----	--	----	---	----	--------------	----	---	----	---	----	---	----	---	----	---------------	----	---	----	---------------	----	--	----	--------------	----	--	----	---	----	--	----	--	----	---	----	-------------------	----	--	----	-----------------	----	---	----	-------------------	----	--	----	---	----	-------------	----	----------------------------------	----	-------------	----	---	----	---	----	--	----	-------------	----	--	----	---	----	---	----	-------------------------	----	---	----	-----------	----	---	----	----------------------	----	---	----	--	----	---	----	--	----	--	----	---	----	---	----	--	----	--	----	---	----	---------------------	----	--	----	---------------	----	---	----	--	----	--	----

# SUBJECT INDEX

## WEATHERING

### WEATHERING

Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C

### WESTERN ARCTIC ALASKA

Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A

### WESTERN CANADA

Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C

### WETLAND SOILS

Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones, W80-00309 2I

### WETLANDS

Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G

### WILDLIFE

Relationship of Vertebrates to Salt Marsh Plants, W80-00038 2I

### WINDS

Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank, W80-00085 2L

### WINTER

Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069 2L

### WISCONSIN

Implementation of Urban Stormwater Runoff Plans, W80-00068 4A

Local Government Response to State-Mandated Land Use Laws, W80-00369 6E

### WITHDRAWAL

Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979, W80-00230 2F

### YUKON TERRITORY

Surface Water Data Yukon and Northwest Territories 1978, W80-00196 4A

### ZOOPLANKTON

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C

Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H

The Contribution of Ammonia Excreted by Zooplankton to Phytoplankton Production in Narragansett Bay, W80-00399 5A

### ZUMBRO RIVER BASIN (MN)

Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C

# AUTHOR INDEX

- ADAMS, B. J.**  
Formulation and Testing of a New Water Quality Index, W80-00304 7B
- ADGATE, K.**  
Land Management Techniques for Stormwater Control in Developed Urban Areas, W80-00052 4C
- ALBERT, R.**  
Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021 2I
- AMBROSINO, G.**  
Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A
- AMODEO, P. A.**  
Comparison of Diurnal Fluctuations of Dissolved Inorganic Carbon and Algal Productivity Estimates in an Oligotrophic and Mesotrophic Freshwater Environment, W80-00002 5C
- ANDELMAN, J. B.**  
Water Reuse of Wastewater from a Poultry Processing Plant, W80-00142 5D
- ANDERSON, C. E.**  
A Review of Structure in Several North Carolina Salt Marsh Plants, W80-00032 2I
- ANDERSON, D.**  
The Economic Implications of Water Re-Use, W80-00257 5D
- ANDERSON, E. L.**  
Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F
- ANDERSON, H. W. JR.**  
Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C
- ANDERSON, J. W.**  
Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C
- ANDERSON, L.**  
Water Rights: The Issue and the Courts, W80-00376 6E
- ANDERSON, M.**  
Development of a Synthetic Municipal Landfill Leachate, W80-00071 5E
- ANDERSON, M. P.**  
Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake, W80-00358 5B
- ANDERSON, R. C.**  
Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C
- ANDREWS, C. B.**  
Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake, W80-00358 5B
- ANDREWS, R. A.**  
An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B
- ARCEMENT, G. J.**  
Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrop, Mississippi, W80-00241 6A
- ARSTILA, A. U.**  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- ASKINS, W.**  
Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex, W80-00112 5D
- ATHAYDE, D.**  
Best Management Practices, W80-00044 4A
- ATWELL, J. S.**  
Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D
- AYER, H. W.**  
Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295 3F
- BAILIN, L. J.**  
Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D
- BAKER, M. B. JR.**  
Modeling Management of Ponderosa Pine Forest Resources, W80-00228 2A
- BAKKE, T.**  
Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C
- BALAKIN, B. A.**  
The Removal of Volatile Suspended Solids from Wastewaters, W80-00103 5D
- BALL, M. S.**  
Sea Changes and the American Republic, W80-00383 6E
- BANCROFT, K.**  
Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I
- BANSAL, S. K.**  
Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*, W80-00392 5C
- BANTA, J. S.**  
The Coastal Commissions and State Agencies: Conflict and Cooperation, W80-00365 6E
- BARBASH, J. E.**  
Hydrocarbons in Sediments from the Edge of the Bermuda Platform, W80-00175 5C
- BARBOUR, M. G.**  
Beach and Salt Marsh Vegetation of the North American Pacific Coast, W80-00031 2I
- BARNETT, H.**  
Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E
- BARTEE, L. D.**  
Land Management Techniques for Developing Areas, W80-00053 4D
- BARTELLS, J. H.**  
Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231 8I
- BARTOS, M. J.**  
Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges, W80-00243 8G
- BASAK, P.**  
Determination of Hydrodynamic Dispersion Coefficients Using 'Inverfc', W80-00073 5B
- BAYER, M. B.**  
Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342 6A
- BAZIER, G.**  
A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- BEARDSLEY, R. C.**  
Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069 2L
- BEDROSYAN, R.**  
Model for Selection of Stormwater Control Alternatives, W80-00318 6B
- BELEVITZEV, A. N.**  
Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D
- BENDER, M. F.**  
Nitrogen Dynamics and Modeling in a Freshwater Wetland, W80-00327 2K
- BENSON, A. A.**  
Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C
- BERGER, A.**  
Growth and Salt Accumulation in Two Annual Species of *Salicornia* from the Mediterranean Coast, (In French), W80-00018 2I
- BERLO, D.**  
Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments, W80-00016 2I
- BERRY, M. P.**  
Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275 3B
- BERTEAU, G. C.**  
Implementation of Urban Stormwater Runoff Plans, W80-00068 4A
- BIELORAI, H.**  
Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G
- BIERI, R. H.**  
Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186 5C
- BIRCH, G. F.**  
Surficial Sediments of Saldanha Bay and Langebaan Lagoon, W80-00012 2J
- BISSONNETTE, P. A.**  
Salmon Processing Wastewater Treatment, W80-00140 5D

# AUTHOR INDEX

BLAIR, S.

- BLAIR, S.**  
Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B
- BLAYLOCK, J. W.**  
Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C
- BOEHM, P. D.**  
A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B
- BOERSMA, L.**  
Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- BOGLE, M. G. V.**  
Stochastic Optimization of a Water Supply System, W80-00397 6A
- BOMBEN, J. L.**  
Effluent Generation, Energy Use and Cost of Blanching, W80-00122 5D
- BORMANN, F. H.**  
Biogeochemistry of a Forested Ecosystem, W80-00328 4C
- BORTHWICK, P. W.**  
Effects of Ground Applications of Malathion on Saltmarsh Environments in Northwestern Florida, W80-00025 5C
- BOUCHER, J.**  
Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities-Preliminary Results, W80-00152 5C
- BOURQUIN, A. W.**  
Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303 2I
- BOWERS, J. A.**  
Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H
- BOYCE, F. M.**  
Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A
- BOYD, C. E.**  
Emergency Aeration of Fish Ponds, W80-00192 8I  
Factors Influencing Shoot Production and Mineral Nutrient Levels in Typha Latifolia, W80-00308 2I
- BRAIDS, O.**  
The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B
- BRAUN, H. E.**  
Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A
- BREBBIA, C. A.**  
Boundary Element Method for Fluid Flow, W80-00083 8B
- BRESLER, E.**  
Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G
- BRIAND, F.**  
Response of Lake Phytoplankton Communities to In Situ Manipulations of Light Intensity and Colour, W80-00400 5A
- BRITTON, L. J.**  
Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G
- BROUSSARD, W. L.**  
Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C
- BROWN, E. D.**  
The Anglo-French Continental Shelf Case, W80-00366 6E
- BROWN, L. R.**  
The Occurrence of 'White Eye Syndrome' in Shrimp (Penaeus Aztecus), W80-00166 5C  
A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- BROWN, P. M.**  
Corrosion and Scale-Formation Properties of Geopressed Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A
- BROWN, P. W.**  
Preliminary Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in the Northeastern United States, W80-00363 6E
- BROWN, S.**  
Alternative Regimes for the Ocean, W80-00377 6E  
The Managemental Fisheries, W80-00378 6E  
Offshore Oil and Gas Exploitation, W80-00379 6E
- BROWN, W. S.**  
Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069 2L
- BUBP, A.**  
Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D
- BUCKS, D. A.**  
Trickle Irrigation: Prevention of Clogging, W80-00074 5F
- BUSSELL, R. B.**  
Capital and Operating Costs of the Existing Dee Radar, Telemetry and Flow Forecasting Project, W80-00333 7B
- BUTLER, J. N.**  
Hydrocarbons in Sediments from the Edge of the Bermuda Platform, W80-00175 5C
- BUTZEVA, I. N.**  
Studies on Wastewater Treatment with Flocculants Application, W80-00099 5D
- BUXTON, A. W.**  
Preliminary Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in the Northeastern United States, W80-00363 6E
- BUXTON, B. M.**  
The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144 5D
- CAMERINO, V.**  
Alaska Native Water Rights as Affected by the Alaska Native Claims Settlement Act, W80-00371 6E
- CAMERON, R. J.**  
Control Rules for Long and Short Term Objectives, W80-00335 2E
- CANALE, R. P.**  
A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- CANEVARI, G. P.**  
The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants, W80-00159 5C
- CASE, H. L. III.**  
Ground-Water Resources of Washington Parish, Louisiana, W80-00227 2F
- CASTLE, R. W.**  
Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161 5C
- CHAMBERS, J. E.**  
Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, Ictalurus Punctatus, W80-00395 5A
- CHANEY, R.**  
Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126 5D
- CHARBONNEAU, R.**  
Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C
- CHARLTON, M. N.**  
Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H
- CHASE, W. L.**  
Wastewater Reuse-How Viable Is It. Another Look, W80-00283 5F
- CHEEVER, D. S.**  
The Law of the Sea: A Rejoinder to Richard G. Darman, W80-00390 6E
- CHEN, C. W.**  
Preliminary Insights into a Three-Dimensional Ecological-Hydrodynamic Model, W80-00214 2H
- CHILDERS, J. M.**  
Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A
- CHITTENDEN, J. A.**  
Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D
- CHRISTIAN, R. R.**  
Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I
- CHUDNOFF, D. A.**  
Legal Aspects of Urban Runoff Development, W80-00293 6E

# AUTHOR INDEX

DENIT, J. D.

- astewater  
5D
- ed by the  
6E
- m Objec-  
2E
- or Water  
gan,  
6A
- s by the  
5C
- on Parish,  
2F
- ersion of  
5C
- Exposure  
fish, Icta-  
5A
- treatment of  
5D
- tribution of  
(Effet du  
s Surfaces  
e),  
2C
- n Central  
ge,  
2H
- t. Another  
5F
- Richard G.  
6E
- imensional  
2H
- ern Arctic  
1A
- ic Lagoon  
5D
- nity Within  
tions,  
2I
- velopment,  
6E
- CHURCH, B. D.**  
Fungal Conversion of Carbohydrate Wastes to  
Animal Feed Protein-Vitamin Supplements,  
W80-00141 5D
- CILLIE, G. G.**  
Current Technology and Research on Re-Use of  
Effluents, W80-00258 5D
- CLAASSEN, H. C.**  
Application of Geochemical Kinetic Data to  
Ground-Water Systems: A Tuffaceous-Rock  
System in Southern Nevada, W80-00232 2K
- CLARK, J. F.**  
Water Recovery Device, W80-00030 2A
- CLARK, R. B.**  
The Effects on Water Quality by Mining Activi-  
ty in the Miami, Arizona Region, W80-00287 5C
- CLESCERI, N. L.**  
Comparison of Diurnal Fluctuations of Dis-  
solved Inorganic Carbon and Algal Productivity  
Estimates in an Oligotrophic and Mesotrophic  
Freshwater Environment, W80-00002 5C
- CLISE, J. D.**  
Water Reuse of Wastewater from a Poultry  
Processing Plant, W80-00142 5D
- CLUFF, C. B.**  
The Compartmented Reservoir: Efficient Water  
Storage in Flat Terrain Areas of Arizona,  
W80-00277 8A
- Rainfall-Runoff Relationships for a Mountain  
Watershed in Southern Arizona,  
W80-00290 3B
- COCHRAN, D.**  
Financing Storm Water Control Projects,  
W80-00065 4A
- CODA, R. L.**  
Water Reuse in a Wet Process Hardboard Manu-  
facturing Plant, W80-00250 5D
- COHEN, J. M.**  
Overview of Physical-Chemical Treatment,  
W80-00098 5D
- COLLIER, C. G.**  
Rainfall Measurement by Radar,  
W80-00329 7B
- COLLINS, C. A.**  
Ground-Water Data in the Baker County-North-  
ern Malheur County Area, Oregon,  
W80-00226 2F
- COLSON, B. E.**  
Backwater at Bridges and Densely Wooded  
Flood Plains, Tallahala Creek at Waldrup, Mis-  
sissippi, W80-00241 6A
- COMEAU, S. P.**  
Geothermal Energy: Problems and Shortcom-  
ings of Classification of a Unique Resource-A  
Look at Problems with Water Law, with Partic-  
ular Emphasis on New Mexico, W80-00388 6E
- CONDON, F. J.**  
Considerations in Characterization of Urban  
Runoff for PL 92-500 Section 208 Planning,  
W80-00045 4A
- CONSTABLE, T. W.**  
BOD/TOC Correlations and Their Application  
to Water Quality Evaluation, W80-00353 5D
- COOK, G. H.**  
Effects of Ground Applications of Malathion on  
Saltmarsh Environments in Northwestern Flor-  
ida, W80-00025 5C
- COOKE, R. C.**  
Bubble Populations and Spectra in Coastal  
Waters: A Photographic Approach,  
W80-00352 2L
- COOLEY, J. F.**  
Hydrocarbon Distribution and Weathering  
Characteristics at a Tropical Oil Spill Site,  
W80-00188 5C
- COON, W.**  
Reuse of Brines in Commercial Cucumber Fer-  
mentations, W80-00128 5D
- Reuse of Fermentation Brines in the Cucumber  
Pickling Industry,  
W80-00251 5D
- COPPAGE, D. L.**  
Effects of Ground Applications of Malathion on  
Saltmarsh Environments in Northwestern Flor-  
ida, W80-00025 5C
- CORAPCIOGLU, M. Y.**  
Diffusion of Dissolved Gas in Consolidating  
Porous Media, W80-00095 2F
- CORNELL, N. W.**  
Alternative Regimes for the Ocean,  
W80-00377 6E
- The Management Fisheries,  
W80-00378 6E
- Offshore Oil and Gas Exploitation,  
W80-00379 6E
- CORNILLON, P. C.**  
Oil Spill Treatment Strategy Modeling for  
Georges Bank, W80-00185 5C
- CORTECCI, G.**  
Tritium and Oxygen Profiles in the Eastern  
Mediterranean, W80-00078 5B
- CORTNER, H. J.**  
Action Programs for Water Yield Improvement  
on Arizona's Watersheds: Political Constraints  
to Implementation, W80-00275 3B
- COTNOIR, L. J.**  
Marsh Soils of the Atlantic Coast,  
W80-00320 2G
- COWELL, E. B.**  
Applications of Ecosystem Analysis to Oil Spill  
Impact, W80-00162 5C
- Problems in Ecological Monitoring in Port  
Valdez, Alaska,  
W80-00189 5C
- COX, C. M.**  
Depression of pH in Lakes and Streams in Cen-  
tral Ontario During Snowmelt,  
W80-00076 2H
- COX, G. V.**  
Applications of Ecosystem Analysis to Oil Spill  
Impact, W80-00162 5C
- CUEMAN, M. K.**  
Chemical Investigations of Two Experimental  
Oil Spills in an Estuarine Ecosystem, Part II,  
W80-00186 5C
- CULP, G. L.**  
Design of Facilities for Physical-Chemical  
Treatment of Raw Wastewater,  
W80-00104 5D
- Field Manual for Performance Evaluation and  
Troubleshooting at Municipal Wastewater  
Treatment Facilities,  
W80-00253 5D
- CURTIS, W. F.**  
Non-Uniform Vertical Distribution of Fine Sedi-  
ment in the Amazon River,  
W80-00220 2J
- CYWIN, A.**  
Physical-Chemical Treatment of Wastewaters  
from the Petroleum Refining-Petrochemical In-  
dustry, W80-00106 5D
- D'OZOUVILLE, L.**  
Occurrence of Oil in Offshore Bottom Sedi-  
ments at the Amoco Cadiz Oil Spill Site,  
W80-00153 5C
- Role of Dynamic Coastal Processes in the  
Impact and Dispersal of the Amoco Cadiz Oil  
Spill (March 1978) Brittany, France,  
W80-00154 5C
- DALELA, R. C.**  
Effect of Distillery Waste on Some Freshwater  
Teleosts-Biochemical Studies,  
W80-00396 5B
- Pesticide Induced Haematological Alterations in  
a Fresh Water Fish *Saccobranchius Fossilis*,  
W80-00392 5C
- DANIEL, J. Y.**  
Ecophysiological Effects of Oil Spills from  
Amoco Cadiz on Pelagic Communities-Prelimi-  
nary Results, W80-00152 5C
- DAVIS, C.**  
Sewage Treatment - The State of the Art,  
W80-00261 5D
- DAVIS, J.**  
Reduction of Wastes from Cucumber Pickle  
Processing by Use of the Controlled Culture  
Fermentation Process,  
W80-00139 5D
- DAVIS, S. E.**  
Tucson's Tools for Demand Management,  
W80-00270 6B
- DE BRUIN, H. A. R.**  
The Priestley-Taylor Evaporation Model Ap-  
plied to a Large, Shallow Lake in the Nether-  
lands, W80-00349 2D
- DE LA CRUZ, A. A.**  
Caloric, Elemental, and Nutritive Changes in  
Decomposing *Juncus Roemerianus* Leaves,  
W80-00307 2I
- DEAN, L. F.**  
Planning for Environmental Management: New  
Directions and Initiatives,  
W80-00386 6E
- DEBORD, F. W.**  
Cold Regions Spill Response,  
W80-00158 5C
- DEMAYO, A.**  
Guidelines for Surface Water Quality, Vol. 1  
Inorganic Chemical Substances Arsenic,  
W80-00194 5C
- DENIT, J. D.**  
Status of EPA's Effluent Guidelines for the  
Food Industry,  
W80-00117 6E

# AUTHOR INDEX

DEPALMA, L. M.

DEPALMA, L. M.

A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A

DEPINTO, J. V.

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

DERECKI, J. A.

Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H

DESORMEAU, C. J.

Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H

DEWLING, R. T.

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

DILLON, P. J.

Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H

Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A

DIXON, R. M.

A Microroughness Meter for Evaluating Rainwater Infiltration, W80-00291 2G

Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G

DORNBUSCH, A. J.

SCS Practices as Related to Sediment and Erosion Control, W80-00054 4D

DRISCOLL, E. D.

Instream Impacts of Urban Runoff, W80-00046 4A

Runoff and Quality, W80-00050 4C

DUCKSTEIN, L.

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

DUNLAP, R. W.

Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108 5D

DUNN, E. L.

Seasonal Patterns of CO<sub>2</sub> and Water Vapor Exchange of Juncus Roemerianus Scheele in a Georgia Salt Marsh, W80-00023 2I

DUNN, S. J.

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

DUNNAHOE, R. G.

Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D

DUNNET, G. M.

Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162 5C

DURBIN, T. J.

Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, W80-00238 2A

DWYER, L.

Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A

DWYER, T. J.

Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I

EATON, J. S.

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

EHRLER, W. L.

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

ELEUTERIUS, L. N.

Silica and Ash in the Salt Marsh Rush, Juncus Roemerianus, W80-00325 2I

ELLIOTT, T. E.

Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D

ENDOH, T.

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

ENGLISH, C. S.

Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona--1977, W80-00239 7C

ERDMANN, D. E.

Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221 1B

Water Analysis, W80-00217 1A

ERNST, H. R.

The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water, W80-00263 5E

ERTZ, D. B.

Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D

ESPINOSA, R.

Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D

ESVELT, L. A.

Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118 5D

EVANS, D. K.

Floristics of the Middle Mississippi River Sand and Mud Flats, W80-00028 2I

EWING, R. L.

Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272 5D

FABIAN, L. L.

Alternative Regimes for the Ocean, W80-00377 6E

The Managerial Fisheries, W80-00378 6E

Offshore Oil and Gas Exploitation, W80-00379 6E

FARB, D.

Information About Hazardous Waste Management Facilities, W80-00245 5D

FARKAS, D. F.

Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E

FARRELL, D. F.

Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C

FEHRINGER, N.

Reuse of Brines in Commercial Cucumber Fermentations, W80-00128 5D

Reuse of Fermentation Brines in the Cucumber Pickling Industry, W80-00251 5D

FELL, P. E.

Estuarine Animals, W80-00302 2L

FERRERA, R. F.

Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223 6G

FFOLIOTT, P. F.

Solar Radiation as Indexed by Clouds for Snowmelt Modeling, W80-00292 2C

FIELD, R. I.

A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator, W80-00057 4A

FIELDEN, J. M.

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C

FIEST, D. L.

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

FINK, D. H.

Salvaging Wasted Waters for Desert-Household Gardening, W80-00285 3D

FISCHER, W. H.

Re-Use of Foreign Waters, W80-00384 6E

FISHMAN, M. J.

Water Analysis, W80-00217 1A

FLEISCHMAN, W. A.

Peatland Policy Study, W80-00317 6E

FLEMING, G.

Real-Time Flood Forecasting for Southern California, W80-00340 2E

FOGEL, M.

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

FORSHT, E. H.

Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D

Status of EPA's Effluent Guidelines for the Food Industry, W80-00117 6E

# AUTHOR INDEX

GUMMER, W. D.

Manage-  
5D  
ication in  
3E  
ver Water-  
7C  
umber Fer-  
5D  
Cucumber  
5D  
2L  
onized on  
Sacramento  
6G  
s for Snow-  
2C  
ewer Over-  
4A  
eavy Metals  
5C  
esent Levels  
tants in the  
5B  
t-Household  
3D  
6E  
1A  
6E  
outhern Cali-  
2E  
urface Mined  
5B  
t of Seafood  
5D  
lines for the  
6E

**FORTIN, J. P.**  
Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C

**FOSTER, K. E.**  
Management Alternatives for Santa Cruz Basin Groundwater, W80-00296 6A

**FOUNTAIN, J.**  
Financing Storm Water Control Projects, W80-00065 4A

**FRANK, R.**  
Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A

**FRASER, A. S.**  
Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

**FRECKLETON, J. R.**  
Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, W80-00238 2A

**FREEMAN, A. M.**  
Air and Water Pollution Policy, W80-00380 6E

**FREEZE, R. A.**  
Stochastic Analysis of Steady State Ground-water Flow in a Bounded Domain 1. One-Dimensional Simulations, W80-00070 2F

**FRENCH, R. H.**  
Interfacial Stability in Channel Flow, W80-00297 2E

**FRIND, E. O.**  
Exact Aquitard Response Functions for Multiple Aquifer Mechanics, W80-00356 2F

**FRONZA, G.**  
Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A

**FULTON, C. W.**  
Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D

**FULTON, J.**  
Wastewater Reuse-How Viable Is It. Another Look, W80-00283 5F

**GABRIEL, B. C.**  
Caloric, Elemental, and Nutritive Changes in Decomposing Juncus Roemerianus Leaves, W80-00307 2I

**GALLAGHER, J. L.**  
Remote Sensing as a Tool for Studying the Ecology of Halophytes, W80-00037 7B

**GALLAGHER, J. L.**  
Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones, W80-00309 2I

**GANCZARZYK, J.**  
Model for Selection of Stormwater Control Alternatives, W80-00318 6B

**GANDURINA, L. B.**  
Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D

**GANDURINA, L. V.**  
Studies on Wastewater Treatment with Flocculants Application, W80-00099 5D

**GANGSTAD, E. O.**  
Weed Control Methods for River Basin Management, W80-00323 2I

**GAPP, D. W.**  
Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295 3F

**GARBARINO, J. R.**  
An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229 7B

**GARNETT, M. J.**  
Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C

**GEARING, J. N.**  
The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

**GEARING, P. J.**  
The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C

**GILBERT, R. G.**  
Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D

**GILBERT, R. G.**  
Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D

**GILBERT, R. G.**  
Trickle Irrigation: Prevention of Clogging, W80-00074 5F

**GIROU, A.**  
Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005 5G

**GIURGEVICH, J. R.**  
Seasonal Patterns of CO2 and Water Vapor Exchange of Juncus Roemerianus Scheele in a Georgia Salt Marsh, W80-00023 2I

**GODFREY, M. M.**  
The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L

**GODFREY, P. J.**  
The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L

**GOFF, J. D.**  
Wastewater Effluent-An Element of Total Water Resource Planning, W80-00284 3C

**GOLANY, P.**  
Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362 4B

**GOMPERS, R.**  
Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B

**GOODRICH, R. D.**  
Nutritive Value of Dried or Ensilaged Aquatic Plants. I. Chemical Composition, W80-00298 2I

**GOODRICH, R. D.**  
Nutritive Value of Dried or Ensilaged Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I

**GORHAM, E.**  
The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I

**GORIATCHEV, N. S.**  
Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

**GRAHL-NIKLSEN, O.**  
Petroleum Hydrocarbons in the North Sea, W80-00178 5C

**GRANT, M. A.**  
The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow, W80-00090 2G

**GRAY, D. H.**  
Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan, W80-00348 2J

**GREENE, D. R.**  
Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337 7B

**GREILING, R. W.**  
Recovery of Soluble Serum Proteins from Meat Industry Wastes, W80-00132 5D

**GRIFFITHS, R. A.**  
The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C

**GROBBELAAR, N. J. H.**  
The Use of Ferric Chloride as a Flocculating Agent in the Treatment of Drinking Water, W80-00263 5E

**GROCHOWSKI, J. P.**  
Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

**GRODEN, T. W.**  
Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H

**GROUZIS, M.**  
Comparative Ecological Requirements of a Perennial and an Annual Salicornia Species: Germination and Growth During the Early Stages of Development, (In French), W80-00010 2I

**GROUZIS, M.**  
Growth and Salt Accumulation in Two Annual Species of Salicornia from the Mediterranean Coast, (In French), W80-00018 2I

**GUARISO, G.**  
Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A

**GULLIVER, J. S.**  
Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D

**GUMMER, W. D.**  
Pesticides Monitoring in the Prairies of Western Canada, W80-00198 5C

# AUTHOR INDEX

## GUNDLACH, E. R.

### GUNDLACH, E. R.

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154 5C

### GUPTA, A. K.

Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*, W80-00392 5C

### GUPTA, V. K.

A Stochastic Kinematic Study of Subsynchronous Space-Time Rainfall, W80-00092 2B

### HAGEDORN, C.

A Comparison of Fluorescein Dye and Antibiotic-Resistant *Escherichia Coli* as Indicators of Pollution in Groundwater, W80-00145 2G

### HAIGHT, J. R.

Potato Juice Processing, W80-00136 5D

### HALFON, E.

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory, W80-00208 2H

### HALLOCK, K.

Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B

### HAM, R.

Development of a Synthetic Municipal Landfill Leachate, W80-00071 5E

### HAMZA, A.

Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143 5D

### HANNI, P. F.

Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124 5D

### HANSEN, G.

Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C

### HANSEN, K.

Oil Spill Treatment Strategy Modeling for Georges Bank, W80-00185 5C

### HANUSOVA, J.

The Uptake of 226Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A

### HARRIS, J.

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

### HARRISON, R.

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

### HARROLD, T. W.

Rainfall Forecasts in the United Kingdom Using Radar Data, W80-00336 2B

### HAPT, H. H.

Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118 5D

### HARVEY, R. A.

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

### HATTULA, M. L.

Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A

### HAVLIK, B.

The Uptake of 226Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A

### HAWKINS, R. H.

Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276 2E

### HAYES, J. M.

Trichlorofluoromethane in Groundwater--A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F

### HAYES, M. O.

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154 5C

### HEALY, R. G.

The Role of the Permit System in the California Coastal Strategy, W80-00364 6E

### HEBRARD, J. P.

Contribution to the Study of Some Bryoassociations of the Subalpine Zone in the Southeast of France (Contribution a l'etude de Quelques Bryoassociations de l'etage Subalpine Dans le Sud-est de la France), W80-00006 2I

### HEIM, G.

Growth and Salt Accumulation in Two Annual Species of *Salicornia* from the Mediterranean Coast, (In French), W80-00018 2I

### HEIM, N. F.

Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, W80-00253 5D

### HELLEBUST, J. A.

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

### HEMPHILL, B. W.

Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D

### HERTZLER, B. L.

Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D

### HESS, K. W.

A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C

### HESS, L. W.

Factors Influencing Shoot Production and Mineral Nutrient Levels in *Typha Latifolia*, W80-00308 2I

### HIBLER, W. D. III.

A Dynamic Thermodynamic Sea Ice Model, W80-00084 2C

### HIGGINS, T. E.

Heavy Metals and Wastewater Reuse, W80-00282 5B

### HIYAMA, Y.

Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187 5C

### HOFFMAN, J. R. H.

Operation and Control of Water Purification Plants, Part II, W80-00262 5E

### HOLDRIEN, M.

Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A

### HOLLORAN, M. F.

Utilization of Oxygen Models in Environmental Impact Analysis, W80-00312 5C

### HOLUB, H.

Arizona Groundwater Law Reform - An Urban Perspective, W80-00271 6E

### HOM, J.

Water Relations of Three Mangrove Species in South Florida, W80-00009 2I

### HOWARD-WILLIAMS, C.

Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period, W80-00313 2H

### HOWARTH, R. W.

Pyrite: Its Rapid Formation in a Salt Marsh and Its Importance to Ecosystem Metabolism, W80-00311 2K

### HUANG, J. Y. C.

An Effective Wastewater Management Program for a Food Processor, W80-00130 5D

### HULT, M. F.

Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240 7C

### HUNEALTY, H.

Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A

### HUNTER, J. V.

Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B

### HUNTER, P.

Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E

### HUTCHINSON, T. C.

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

### HYDE, D.

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

### HYLAND, J. L.

Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, *Ilyanassa Obsoleta*, W80-00174 5C

# AUTHOR INDEX

KROCHTA, J. M.

- ce Model, 2C
- 5B
- and Sea Oil
- 5C
- Purification
- 5E
- EB in Surf- Cores (1976)
- 5A
- Environmental
- 5C
- An Urban
- 6E
- e Species in
- 2I
- frican Lake: Recent Dry
- 2H
- Marsh and
- olism, 2K
- ent Program
- 5D
- iver Water-
- 7C
- ganochlorine on, 5A
- Hydrocarbon
- 5B
- c Sludge Di- industry, 5E
- ility to Tox- rane Effects, 5C
- ulation Capa-
- 2A
- cally-Evoked ail, Ilyanassa
- 5C
- IBBOTSON, B.**  
Formulation and Testing of a New Water Quality Index, W80-00304 7B
- ITASAKA, M.**  
Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C
- JACKSON, M. L.**  
Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D
- JANKE, D. M.**  
Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I
- JEFFRIES, D. S.**  
Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H
- Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A
- JENNINGS, J. R.**  
Accumulation of Cadmium by *Dunaliella Tertiolecta* Butcher, W80-00398 5A
- JENSEN, E. T.**  
State/Local Interaction in Stormwater Management, W80-00062 4A
- JOHNSEN, T. M.**  
Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C
- JOHNSON, A. H.**  
Acidification of Headwater Streams in the New Jersey Pine Barrens, W80-00354 5B
- JOHNSON, B. D.**  
Bubble Populations and Spectra in Coastal Waters: A Photographic Approach, W80-00352 2L
- JOHNSON, D. L.**  
Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D
- JOHNSON, G. V.**  
Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274 5F
- JOHNSON, N. M.**  
Biogeochemistry of a Forested Ecosystem, W80-00328 4C
- JOHNSON, R. A.**  
A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- JOHNSON, R. B.**  
Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona, W80-00269 4B
- JOHNSON, R. B. JR.**  
Fishery Survey of Cedar Lakes and the Brazos and San Bernard River Estuaries, W80-00305 2H
- JOHNSON, W. D.**  
Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6C
- JOHNSTON, L. M.**  
Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K
- JORDAN, P. R.**  
Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224 7B
- JOSEPH, J.**  
Botanical Control: Purifying Industrial Wastewater, W80-00266 5D
- KADLEC, J. A.**  
Effects of a Drawdown on a Waterfowl Impoundment, W80-00315 2H
- KAPLAN, W.**  
Denitrification in a Salt Marsh Ecosystem, W80-00355 2L
- KAPPLE, G. W.**  
Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Groundwater Basin, California, W80-00238 2A
- KARINEN, J. F.**  
Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C
- KAUSS, P.**  
Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C
- KELJMAN, J. Q.**  
The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349 2D
- KEILANI, W. M.**  
A Water Quality Economic Index, W80-00346 6B
- KEITH, S. J.**  
Ephemeral Flow and Water Quality Problems: A Case Study of the San Pedro River in South-eastern Ariz., W80-00281 2E
- KELLER, E. A.**  
The Fluvial System: Selected Observations, W80-00019 2E
- KELLEY, R. N.**  
Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H
- KEMP, A. L. W.**  
Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K
- Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A
- KEMPF, J.**  
Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B
- KERNODLE, D. R.**  
Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A
- KERR, C. L.**  
A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C
- KHARAKA, Y. K.**  
Corrosion and Scale-Formation Properties of Geopressured Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A
- KIESSER, S. L.**  
Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171 5C
- KILLEN, J. M.**  
Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D
- KIM, J. R.**  
Factors for Predicting Commercial Water Use, W80-00203 6D
- KIRSCHTEN, D.**  
The Quiet Before the Shootout Over 'The Water Law of the West', W80-00360 6E
- KISSAM, A.**  
Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127 5E
- KLOPATEK, J. M.**  
Primary Productivity of Emergent Macrophytes in a Wisconsin Marsh Ecosystem, W80-00026 2I
- KOEHLER, R. B.**  
Effectiveness of Sealing Southeastern Arizona Stock Ponds with Soda Ash, W80-00278 4A
- KOHLI, B.**  
Mass Exchange Between Hamilton Harbour and Lake Ontario, W80-00343 2H
- KONIECZKI, A. D.**  
Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977, W80-00239 7C
- KOONS, C. B.**  
C15+Hydrocarbons in the Sediments of the New York Bight, W80-00177 5C
- KORSHAK, V. V.**  
Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D
- KORYAK, M.**  
Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania, W80-00029 2I
- KRAEUTER, J. N.**  
The Relationship of Marine Macroinvertebrates to Salt Marsh Plants, W80-00321 2I
- KRAPU, G. L.**  
Use of Prairie Pothole Habitat by Breeding Mallards, W80-00322 2I
- KREES, R.**  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- KROCHTA, J. M.**  
Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E

# AUTHOR INDEX

KRZYSZTOFOWICZ, R.

KRZYSZTOFOWICZ, R.

Comment on 'Value of Information in Reservoir Optimization' by V. Klemes, W80-00147 6A

KUBOTA, S.

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

LACY, W. J.

Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106 5D

LADNER, C. M.

The Occurrence of 'White Eye Syndrome' in Shrimp (*Penaeus Aztecus*), W80-00166 5C

LAGER, J. A.

Applications of Stormwater Management Models, W80-00051 4A

Collection System Control, W80-00056 4A

Impact of CSO/SSD on Water Quality, W80-00048 4A

LAM, D. C. L.

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

LAMB, A.

Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D

LAMBERT, A. O.

Control Rules for Long and Short Term Objectives, W80-00335 2E

LANE, L. J.

Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289 2J

Sediment Yield Equation from an Erosion Simulation Model, W80-00280 2J

Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279 2G

LANGENEGGER, D.

Richards Bay Mzingazi Water Purification Works, W80-00268 5F

LANNING, F. C.

Silica and Ash in the Salt Marsh Rush, *Juncus Roemerianus*, W80-00325 2I

LASETER, J. L.

Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C

LAUFER, A.

Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091 2G

LAUGHLIN, R. B. JR.

The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, *Rhithropanopeus Harrisi*, W80-00172 5C

LAVALLE, P. D.

Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345 5A

LAZAR, M. E.

Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E

LEFEVRE, J.

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities—Preliminary Results, W80-00152 5C

LEITMAN, H. M.

Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041 2I

LELAND, H. V.

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C

LEONHART, L.

Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288 5B

LEVCHENKO, M. N.

Treatment of Chemical Plant Effluents, W80-00101 5D

LEWIS, A. L.

Virus Consideration in Land Disposal of Sewage Effluents and Sludge, W80-00306 5A

LEYTHAM, K. M.

Real-Time Flood Forecasting for Southern California, W80-00340 2E

LIAO, P. B.

Salmon Processing Wastewater Treatment, W80-00140 5D

LICO, M. S.

Corrosion and Scale-Formation Properties of Geopressed Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219 1A

LIKENS, G. E.

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

LIN, J.-T.

Effects of an Oil Slick on Wind Waves, W80-00183 5C

LIN, S. S.

Salmon Processing Wastewater Treatment, W80-00140 5D

LINN, J. G.

Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition, W80-00298 2I

Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I

LINTHURST, R. A.

An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I

LISSAUER, I. M.

Oil Spill Forecasting—Where Is It Going, W80-00181 5C

LITTLE, L. W.

Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D

LIU, H.-T.

Effects of an Oil Slick on Wind Waves, W80-00183 5C

LIU, P. L.-F.

Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F

LOEFFLER, R. M.

Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233 1A

LOWING, M. J.

Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E

LUIS, V. S.

Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives, W80-00135 5D

LUKINYKH, N. A.

Fundamental Principles of Selecting the Method for Processing Sewage Sediments in Accordance with Their Properties, W80-00115 5D

LUOMA, S. N.

Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237 5C

LURIE, U. U.

Examination of Oil-Containing Waste Waters Chemical Composition After Their Treatment in Aeration Tanks, W80-00107 5A

MACDONALD, K. B.

Beach and Salt Marsh Vegetation of the North American Pacific Coast, W80-00031 2I

MACE, A. C.

Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C

MACIOLEK, J. A.

Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G

MACKAY, D.

Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160 5C

Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167 5C

MACKENZIE, M. J.

Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357 5B

MADDOX, G. E.

Use of Digital Models to Manage Ground Water, W80-00252 2F

MAGONO, C.

Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C

MAHALINGAM, R.

Immobilization of Hazardous Residues by Encapsulation, W80-00256 5D

# AUTHOR INDEX

MULYK, P.

- MAINWARING, P.**  
Installation and Operation of the Dee Telemetry System, W80-00332 7B
- MALINKY, G.**  
Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments, W80-00176 5C
- MALONEY, F. E.**  
Legal Aspects of Urban Storm Water Management and Related Pollution Abatement Problems, W80-00064 4A
- MALONEY, R.**  
Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C
- MAREK, A. C.**  
Advanced Wastewater Treatment for an Organic Chemicals Manufacturing Complex, W80-00112 5D
- MARGANIAN, V. M.**  
Control of Salt Marsh Culicoides and Tabanus Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013 5C
- MARKS, R. H.**  
The Economic Implications of Water Re-Use, W80-00257 5D
- MARSH, G. D.**  
Cold Regions Spill Response, W80-00158 5C
- MARTIN, C. W.**  
Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hampshire, W80-00201 2K
- MATTSON, J. S.**  
Compensating States and the Federal Government for Damages to Natural Resources Resulting from Oil Spills, W80-00387 6E
- MAXIMENKO, JU. L.**  
Studies on Oxidation Processes of Cyanides and Phenols in Waste and Natural Waters by Using Chlorine Dioxide, W80-00109 5D
- MAY, M. S. III.**  
Probable Agents for the Formation of Detritus from the Halophyte, *Spartina Alterniflora*, W80-00036 2I
- MAYO, D. W.**  
Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188 5C
- MAYSNIKOV, I. N.**  
Studies on Wastewater Treatment with Flocculants Application, W80-00099 5D
- MCADA, D. P.**  
Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292 2C
- MCBEAN, E. R.**  
BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353 5D
- MCCORKLE, F. M.**  
Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, *Ictalurus Punctatus*, W80-00395 5A
- MCCOY, E. L.**  
A Comparison of Fluorescein Dye and Antibiotic-Resistant *Escherichia Coli* as Indicators of Pollution in Groundwater, W80-00145 2G
- MCCUEN, R. H.**  
Factors for Predicting Commercial Water Use, W80-00203 6D
- MCFEETERS, R. F.**  
Reuse of Brines in Commercial Cucumber Fermentations, W80-00128 5D  
Reuse of Fermentation Brines in the Cucumber Pickling Industry, W80-00251 5D
- MCGOWAN, I.**  
A Microroughness Meter for Evaluating Rainwater Infiltration, W80-00291 2G
- MCMICHAEL, F. C.**  
Comparison of Alternative Strategies for Coke Plant Wastewater Disposal, W80-00108 5D
- MCMILLAN, C.**  
Salt Tolerance of Mangroves and Submerged Aquatic Plants, W80-00033 2I
- MCNAUGHT, D. C.**  
Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205 2H
- MCNEELY, R. N.**  
Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A
- MCNELLIS, J. M.**  
Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224 7B
- MEADE, N. F.**  
Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C
- MEADE, R. H.**  
Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2J
- MEEAHAN, J. G.**  
Economic Return on Pollution Control Expenditures for the Pickled Food Industry, W80-00131 5D
- MEISKE, J. C.**  
Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition, W80-00298 2I  
Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep, W80-00299 2I
- MEISNER, B. N.**  
Ridge Regression--Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350 2B
- MEYERS, S. P.**  
Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry, W80-00137 5D
- MIASNIKOV, I. N.**  
The Removal of Volatile Suspended Solids from Wastewaters, W80-00103 5D
- MICHEL, J.**  
Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C
- MICKLIN, P. P.**  
International Environmental Implications of Soviet Development of the Volga River, W80-00368 6E
- MILLER, D.**  
The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B
- MILLER, D. C.**  
Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, *Ilyanassa Obsoleta*, W80-00174 5C
- MILLER, P. C.**  
Water Relations of Three Mangrove Species in South Florida, W80-00009 2I
- MINCHEW, C. D.**  
The Occurrence of 'White Eye Syndrome' in Shrimp (*Penaeus Aztecus*), W80-00166 5C
- MING, C. O.**  
Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241 6A
- MOAL, J.**  
Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C
- MOCHNACKA-LAWACZ, H.**  
Seasonal Changes of Phragmites Communis Trin. Part I. Growth, Morphometrics, Density and Biomass, W80-00011 2I
- MOLES, A.**  
Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C
- MONK, D. C.**  
Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189 5C
- MOORE, J. A.**  
The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144 5D
- MORGAN, J. P.**  
Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124 5D
- MORIN, G.**  
Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C
- MOSESMAN, N.**  
A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B
- MOUNTAIN, C. W.**  
Virus Consideration in Land Disposal of Sewage Effluents and Sludge, W80-00306 5A
- MUDIE, P. J.**  
The Potential Economic Uses of Halophytes, W80-00040 6C
- MULYK, P.**  
Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138 5D

# AUTHOR INDEX

MURPHY, D. L.

MURPHY, D. L.

Oil Spill Forecasting--Where Is It Going,  
W80-00181

5C

MURPHY, W. R. JR.

Flood Profiles of the Pithlachascotee River,  
West-Central Florida,  
W80-00225

2E

MURTY, V. V. N.

Determination of Hydrodynamic Dispersion Co-  
efficients Using 'Inverfo',  
W80-00073

5B

MUSCH, S.

A Telemetry System Working Through the  
Public Telephone Network,  
W80-00339

2E

MYHRMAN, M.

Rainfall-Runoff Relationships for a Mountain  
Watershed in Southern Arizona,  
W80-00290

3B

NADEAU, S.

Behavior and Effectiveness of Dispersants at Sea  
and at Shorelines,  
W80-00160

5C

NAKAYAMA, F. S.

Trickle Irrigation: Prevention of Clogging,  
W80-00074

5F

NARASIMHAN, T. N.

The Significance of the Storage Parameter in  
Saturated-Unsaturated Groundwater Flow,  
W80-00094

2F

NEAL, R.

Application of Fine Screens in the Treatment of  
Food Processing Wastewater,  
W80-00126

5D

NEFF, J. M.

The Interactive Effects of Temperature, Salin-  
ity, and Sublethal Exposure to Phenanthrene, a  
Petroleum-Derived Polycyclic Aromatic Hy-  
drocarbon (PAH), on the Respiration Rate of  
Juvenile Mud Crabs, *Rhithropanopeus harrisi*,  
W80-00172

5C

NEIMANIS, V. P.

Water Quality Sourcebook. A Guide to Water  
Quality Parameters,  
W80-00200

2A

NEUMANN, H. J.

Commercial Feasibility of Recovering Tomato  
Peeling Residuals,  
W80-00124

5D

NG, C.

Behavior and Effectiveness of Dispersants at Sea  
and at Shorelines,  
W80-00160

5C

NICHOLS, J. A.

Ten-Year Overview of Oil Spill Clean-Up at  
Sea,  
W80-00155

5C

NICKESON, S.

Alaska Native Water Rights as Affected by the  
Alaska Native Claims Settlement Act,  
W80-00371

6E

NIJKAMP, P.

Theory and Application of Environmental Eco-  
nomics,  
W80-00027

6A

NORDIN, C. F. JR.

Non-Uniform Vertical Distribution of Fine Sedi-  
ment in the Amazon River,  
W80-00220

2J

NORTON, S. E.

Stream Channel Modification in Hawaii. Part B:  
Effect of Channelization on the Distribution and  
Abundance of Fauna in Selected Streams,  
W80-00004

6G

NOTO, P.

Tritium and Oxygen Profiles in the Eastern  
Mediterranean,  
W80-00078

5B

NOV, A.

Optimization of a Dam System for Recharging  
Runoff Water into the Ground,  
W80-00362

4B

O'HAYRE, A. P.

Regional Analysis of Economic Activity, Re-  
source Management and Lake Eutrophication: A  
Case Study of Itasca County, Minnesota,  
W80-00254

5C

O'SULLIVAN, M. J.

Stochastic Optimization of a Water Supply  
System,  
W80-00397

6A

OLMSTEAD, N. C.

Estuarine Animals,  
W80-00302

2L

ONDRECHEN, W. T.

Comparing Water Supply Forecast Techniques,  
W80-00202

2A

ORSI, L. E.

Control of Odors from an Anaerobic Lagoon  
Treating Meat Packing Wastes,  
W80-00119

5D

OSBORN, H. B.

Effectiveness of Sealing Southeastern Arizona  
Stock Ponds with Soda Ash,  
W80-00278

4A

OSTERKAMP, W. R.

Guidelines for the Use of Structural Versus Re-  
gression Analysis in Geomorphic Studies,  
W80-00224

7B

OSTROVSKY, O. P.

Processing and Neutralization of Industrial  
Wastes from Iron and Steel Effluents Treatment,  
W80-00114

5D

OTTERBY, D. E.

Nutritive Value of Dried or Ensiled Aquatic  
Plants. I. Chemical Composition,  
W80-00298

2I

Nutritive Value of Dried or Ensiled Aquatic  
Plants. II. Digestibility by Sheep,  
W80-00299

2I

OVERTON, E. B.

Chemical Characterization of Mousse and Se-  
lected Environmental Samples from the Amoco  
Cadiz Oil Spill,  
W80-00151

5C

PAGE, D. S.

Hydrocarbon Distribution and Weathering  
Characteristics at a Tropical Oil Spill Site,  
W80-00188

5C

PALERMO, M. R.

Physical and Engineering Properties of Hazard-  
ous Industrial Wastes and Sludges,  
W80-00243

8G

PALNIKAR, M. P.

Reuse of Brines in Commercial Cucumber Fer-  
mentations,  
W80-00128

5D

PALNITKAR, M. P.

Reuse of Fermentation Brines in the Cucumber  
Pickling Industry,  
W80-00251

5D

PANOVA, V. A.

Examination of Oil-Containing Waste Waters  
Chemical Composition After Their Treatment in  
Aeration Tanks,  
W80-00107

5A

PARK, R. A.

Modifications to the Model Cleaner Requiring  
Further Research,  
W80-00209

2H

PARRISH, J. D.

Stream Channel Modification in Hawaii. Part B:  
Effect of Channelization on the Distribution and  
Abundance of Fauna in Selected Streams,  
W80-00004

6G

PASCHINI, E.

On the Green's Function of Laplace's Tidal  
Equation, an Application to the Northern Adri-  
atic Sea,  
W80-00079

2L

PATEL, J. R.

Chemical Characterization of Mousse and Se-  
lected Environmental Samples from the Amoco  
Cadiz Oil Spill,  
W80-00151

5C

PAYNE, J. F.

Are Petroleum Hydrocarbons an Important  
Source of Mutagens in the Marine Environment,  
W80-00165

5C

PEPPER, I. L.

Nitrogen Removal from Secondary Effluent Ap-  
plied to a Soil-Turf Filter,  
W80-00274

5F

PERKINS, B. E.

Recovery and Application of Organic Wastes  
from the Louisiana Shrimp Canning Industry,  
W80-00137

5D

PEROFF, K. S.

Local Government Response to State-Mandated  
Land Use Laws,  
W80-00369

6E

PERSOONS, E.

A Telemetry System Working Through the  
Public Telephone Network,  
W80-00339

2E

PETERS, R. H.

A Water Quality Economic Index,  
W80-00346

6B

PICKERING, J. A.

An Economic and Environmental Evaluation of  
Alternative Land Development Around Lakes,  
W80-00148

6B

PIERCE, R. S.

Biogeochemistry of a Forested Ecosystem,  
W80-00328

4C

PINDER, G. F.

A Direct Solution to the Inverse Problem in  
Groundwater Flow,  
W80-00081

2F

PISANO, W. C.

Cost Effective Approach for Combined Storm  
and Sewer Clean-Up,  
W80-00055

4A

PLATT, R. H.

Coastal Hazards and National Policy: A Jura-  
Rig Approach,  
W80-00370

6E

POERTNER, H. G.

Land Use and Urban Development Affecting  
Stormwater Pollution and Water Quality,  
W80-00047

4A

Urban Stormwater Detention and Flow Attenu-  
ation for Pollution Control,  
W80-00059

4A

Urban Stormwater Management Problems and  
Solutions--Overview of a Nationwide Study,  
W80-00060

4A

# AUTHOR INDEX

ROZYCKI, S. Z.

- POLEY, J. P.**  
Selective Oil Spill Combat Planning for Off-shore Exploration and Production Operations in the North Sea, W80-00180 5C
- POLIS, C.**  
Obtaining Access to Solar Energy: Nuisance, Water Rights, and Zoning Administration, W80-00382 6E
- POLTA, R.**  
The Operation of the Physical-Chemical Plant at Rosemount, Minnesota, W80-00100 5D
- PONOMAREV, V. G.**  
Treatment of Concentrated Waste Waters Containing Oil Emulsions, W80-00111 5D
- POOLE, D. K.**  
Water Relations of Three Mangrove Species in South Florida, W80-00009 2I
- POPP, M.**  
Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021 2I
- POWERS, W. F.**  
A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213 6A
- PRICE, D.**  
Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979, W80-00230 2F
- PRICE, N. B.**  
Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220 2I
- PRICE, R. K.**  
Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E
- PUTMAN, F.**  
Rainfall-Runoff Relationships for a Mountain Watershed in Southern Arizona, W80-00290 3B
- QUADFASSEL, D.**  
Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B
- QUEIROZ, C. S.**  
Systematic Sampling of Gaussian Random Processes and Fields, W80-00089 2F
- QUINN, F. H.**  
Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H
- Relative Accuracy of Connecting Channel Discharge Data with Application to Great Lakes Studies, W80-00347 2E
- QUINN, J. C.**  
The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C
- RAHE, T. M.**  
A Comparison of Fluorescein Dye and Antibiotic-Resistant *Escherichia Coli* as Indicators of Pollution in Groundwater, W80-00145 2G
- RAHIMTULA, A.**  
Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165 5C
- RAINBOW, P. S.**  
Accumulation of Cadmium by *Dunaliella Tertiolecta* Butcher, W80-00398 5A
- RAJ, P. P. K.**  
The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C
- RAMIREZ, E. R.**  
Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121 5D
- RECKHOW, K. H.**  
Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H
- REED, M.**  
A Fishery-Oil Spill Interaction Model, W80-00150 5C
- REEDER, S. W.**  
Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic, W80-00194 5C
- REETER, C. V.**  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- REIMOLD, R. J.**  
An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I
- Mathematical Modeling-Spartina, W80-00034 2I
- REUNANEN, H.**  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- REYNOLDS, P. J.**  
A Water Quality Economic Index, W80-00346 6B
- REZNIKOV, U. N.**  
Processing and Neutralization of Industrial Wastes from Iron and Steel Effluents Treatment, W80-00114 5D
- RICE, R. C.**  
Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286 5D
- Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273 5D
- RICE, S. D.**  
Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C
- RIPKEN, J. F.**  
Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247 5D
- RIZKALLA, A. S.**  
Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184 5C
- ROBERTS, B. H.**  
Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B
- ROBERTS, D. J.**  
Installation and Operation of the Dee Telemetry System, W80-00332 7B
- ROBERTSON, A.**  
The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H
- ROBERTSON, G. H.**  
Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125 3E
- ROBINSON, A. H.**  
Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E
- ROBINSON, A. K.**  
Aircraft Industry Wastewater Recycling, W80-00255 5D
- ROMMEL, G. W.**  
Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C
- ROQUES, H.**  
Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005 5G
- ROSE, W. W.**  
Tomato Cleaning, Water Recycle and Mud Dewatering, W80-00120 5D
- ROSENAU, J. R.**  
Potato Juice Processing, W80-00136 5D
- ROSSI, S. S.**  
Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170 5C
- ROTHSCHILD, H.**  
Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G
- ROUVET, J. C.**  
A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- ROWE, M. L.**  
Treatment of Packinghouse Wastewater by Sand Filtration, W80-00129 5D
- ROWSE, A. A.**  
Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331 7B
- ROZEMA, J.**  
The Influence of Salinity, Inundation and Temperature on the Germination of Some Halophytes and Non-Halophytes, W80-00022 2I
- ROZYCKI, S. Z.**  
Use of Complex Paleogeographic Method to Recognize the History of Distrophic Lakes and High Bogs as Exemplified by an Interglacial Lake at Golkow Near Warszawa, W80-00007 2H

# AUTHOR INDEX

RUSK, D.

- RUSK, D.  
Sea Changes and the American Republic,  
W80-00383 6E
- SAAD, S.  
Water Reuse in Poultry Processing: Case Study  
in Egypt,  
W80-00143 5D
- SABATINO, T.  
Contribution of Urban Runoff to Hydrocarbon  
Pollution,  
W80-00357 5B
- SAGAR, B.  
Solution of Linearized Boussinesq Equation with  
Stochastic Boundaries and Recharge,  
W80-00093 2F
- SAHOTA, H. S.  
Prediction of the Motion of Oil Spills in Cana-  
dian Arctic Waters,  
W80-00184 5C
- SALUSTI, E.  
On the Green's Function of Laplace's Tidal  
Equation, an Application to the Northern Adri-  
atic Sea,  
W80-00079 2L
- SAMAIN, J. F.  
Ecophysiological Effects of Oil Spills from  
Amoco Cadiz on Pelagic Communities--Prelimi-  
nary Results,  
W80-00152 5C
- SANDERSON, M.  
Surface Loading from Pollutants in Precipitation  
in Southern Ontario: Some Climatic and Statisti-  
cal Aspects,  
W80-00345 5A
- SCAVIA, D.  
The Examination of Ecosystem Properties of  
Lake Ontario Through the Use of an Ecological  
Model,  
W80-00215 2H
- The Use of Ecological Models of Lakes in Syn-  
thesizing Available Information and Identifying  
Research Needs,  
W80-00210 2H
- CHADE, J. E.  
Commercial Feasibility of Recovering Tomato  
Peeling Residuals,  
W80-00124 5D
- CHIEDER, W. A.  
Effects of Acidic Precipitation on Precambrian  
Freshwaters in Southern Ontario,  
W80-00344 5A
- SCHOTT, F.  
Lagrangian and Eulerian Measurements of Hori-  
zontal Mixing in the Baltic,  
W80-00359 5B
- SCHRIER, E.  
Decision Criteria for the Chemical Dispersion of  
Oil Spills,  
W80-00161 5C
- SCHULTZ, L. A.  
Cold Regions Spill Response,  
W80-00158 5C
- SCHULTZ, W. G.  
Commercial Feasibility of Recovering Tomato  
Peeling Residuals,  
W80-00124 5D
- SEBASTIAN, F. P.  
Cost Benefits of Physical Chemical Treatment,  
W80-00113 5D
- SEKITS, D. F.  
Aircraft Industry Wastewater Recycling,  
W80-00255 5D

- SEPASKHAH, A. R.  
Thermal Conductivity of Soils as a Function of  
Temperature and Water Content,  
W80-00146 2G
- SEXTON, W. J.  
Occurrence of Oil in Offshore Bottom Sedi-  
ments at the Amoco Cadiz Oil Spill Site,  
W80-00153 5C
- SHAMEL, R.  
Economic Assessment of Potential Hazardous  
Waste Control Guidelines for the Inorganic  
Chemicals Industry,  
W80-00249 6B
- SHANHOLTZER, G. F.  
Relationship of Vertebrates to Salt Marsh Plants,  
W80-00038 2I
- SHAW, D. G.  
Modeling the Association of Petroleum Hydro-  
carbons and Sub-Arctic Sediments,  
W80-00176 5C
- SHEN, C. C.  
Single Cell Protein from Food Wastes by the  
Deep Tank Process,  
W80-00134 5D
- SHIRLEY, E. D.  
Sediment Yield Equation from an Erosion Simu-  
lation Model,  
W80-00280 2J
- SHOEMAKER, W. J.  
Financing Stormwater Projects,  
W80-00066 4A
- Legal Aspects of Urban Stormwater Manage-  
ment,  
W80-00063 4A
- SHOLKOVITZ, E. R.  
Non-Uniform Vertical Distribution of Fine Sedi-  
ment in the Amazon River,  
W80-00220 2J
- SILVA, C. C.  
Impact of Dispersant Use During the Brazilian  
Marina Incident,  
W80-00156 5C
- SILVER, R. M.  
Geothermal Energy: Problems and Shortcom-  
ings of Classification of a Unique Resource-A  
Look at Problems with Water Law, with Partic-  
ular Emphasis on New Mexico,  
W80-00388 6E
- SIMANTON, J. R.  
Effectiveness of Sealing Southeastern Arizona  
Stock Ponds with Soda Ash,  
W80-00278 4A
- A Microroughness Meter for Evaluating Rain-  
water Infiltration,  
W80-00291 2G
- Simple Time-Power Functions for Rainwater In-  
filtration and Runoff,  
W80-00279 2G
- SIVA, J. L.  
Ecological Impacts of Oil Spill Cleanup: Are  
They Significant,  
W80-00163 5C
- SLAPPEY, S. G.  
Who Will Reap the Mineral Riches of the Deep,  
W80-00375 6E
- SLEETER, T. D.  
Hydrocarbons in Sediments from the Edge of  
the Bermuda Platform,  
W80-00175 5C
- SMITH, D. J.  
Preliminary Insights into a Three-Dimensional  
Ecological-Hydrodynamic Model,  
W80-00214 2H

- SMITH, K. C.  
Process for Treatment of Sewage in a Gravity  
Sewer,  
W80-00008 5D
- SMITH, L.  
Stochastic Analysis of Steady State Ground-  
water Flow in a Bounded Domain I. One-Di-  
mensional Simulations,  
W80-00070 2F
- SNELL, J. H.  
Roodepoort Now Handles Own Wastewater,  
W80-00267 5D
- SNODGRASS, W. J.  
Predictive Water Quality Models for the Great  
Lakes: Some Capabilities and Limits,  
W80-00211 2H
- Utilization of Oxygen Models in Environmental  
Impact Analysis,  
W80-00312 5C
- SOLLERS, S. C.  
Substrate Conditions, Community Structure and  
Succession in a Portion of the Floodplain of  
Wissahickon Creek,  
W80-00310 2B
- SONG, C. C. S.  
Velocity Profiles and Minimum Stream Power,  
W80-00077 2E
- SOERENSON, E.  
Hydrocarbon Distribution and Weathering  
Characteristics at a Tropical Oil Spill Site,  
W80-00188 5C
- SOREY, M. L.  
The Compressibility and Hydraulic Diffusivity  
of a Water-Steam Flow,  
W80-00090 2G
- SOUPROUN, U. M.  
Processing and Neutralization of Industrial  
Wastes from Iron and Steel Effluents Treatment,  
W80-00114 5D
- SPAULDING, M. L.  
A Fishery-Oil Spill Interaction Model,  
W80-00150 5C
- Oil Spill Treatment Strategy Modeling for  
Georges Bank,  
W80-00185 5C
- SPENCER, R. R.  
Azomethine H Colorimetric Method for Deter-  
mining Dissolved Boron in Water,  
W80-00221 1B
- SPRAGGS, L. D.  
Comparison of Finite Element and Finite Differ-  
ence Methods in Thermal Discharge Investiga-  
tions,  
W80-00082 5B
- STABA, E. J.  
Nutritive Value of Dried or Ensilaged Aquatic  
Plants. I. Chemical Composition,  
W80-00298 2I
- Nutritive Value of Dried or Ensilaged Aquatic  
Plants. II. Digestibility by Sheep,  
W80-00299 2I
- STAMOUDIS, V. C.  
Chemical Investigations of Two Experimental  
Oil Spills in an Estuarine Ecosystem, Part II,  
W80-00186 5C
- STANFORTH, R.  
Development of a Synthetic Municipal Landfill  
Leachate,  
W80-00071 5E
- STANGLE, B.  
Economic Assessment of Potential Hazardous  
Waste Control Guidelines for the Inorganic  
Chemicals Industry,  
W80-00249 6B

# AUTHOR INDEX

VERMA, S. R.

Gravimetry  
5D  
Groundwater  
One-Dimensional  
2F  
Water  
5D  
The Great  
2H  
Environmental  
5C  
Structure and  
Explanation of  
2B  
Power  
2E  
Weathering  
Site  
5C  
Diffusivity  
2G  
Industrial  
Treatment  
5D  
5C  
5C  
For Deter-  
1B  
Site Differ-  
Investiga-  
5B  
Aquatic  
2I  
Aquatic  
2I  
Experimental  
Part II  
5C  
Landfill  
5E  
Hazardous  
Inorganic  
6B

- STARK, L. M.**  
Virus Consideration in Land Disposal of Sewage  
Effluents and Sludge, W80-00306 5A
- STEARNS, F. W.**  
Primary Productivity of Emergent Macrophytes  
in a Wisconsin Marsh Ecosystem, W80-00026 2I
- STEEL, S. H.**  
Relationships Between Respiratory Cancer and  
Wetlands Residency in Louisiana, W80-00015 6G
- STEGMANN, R.**  
Development of a Synthetic Municipal Landfill  
Leachate, W80-00071 5E
- STEINHAEUER, W. G.**  
A Chemical Assessment of the Present Levels  
and Sources of Hydrocarbon Pollutants in the  
Georges Bank Region, W80-00157 5B
- STOEBNER, K.**  
Alaska Native Water Rights as Affected by the  
Alaska Native Claims Settlement Act, W80-00371 6E
- STONE, F.**  
Preliminary Evaluation of Anaerobic Sludge Di-  
gestion for the Tuna Processing Industry, W80-00127 5E
- STRACHAN, W. M. J.**  
Polychlorinated Biphenyls and Organochlorine  
Pesticides in Great Lakes Precipitation, W80-00086 5A
- STRAUGHAN, D.**  
Distribution of Tar and Relationship to Changes  
in Intertidal Organisms on Sandy Beaches in  
Southern California, W80-00173 5B
- SUBRAMANIAN, R. V.**  
Immobilization of Hazardous Residuals by En-  
capsulation, W80-00256 5D
- TAGATZ, M. E.**  
Effects of Ground Applications of Malathion on  
Saltmarsh Environments in Northwestern Flori-  
da, W80-00025 5C
- TAM, D.**  
Relationship of Hydrocarbon Solubility to Tox-  
icity in Algae and Cellular Membrane Effects,  
W80-00167 5C
- TANG, D. H.**  
A Direct Solution to the Inverse Problem in  
Groundwater Flow, W80-00081 2F
- TAYLOR, B. C.**  
A System for Real-Time Processing Transmis-  
sion and Display of Radar-Derived Rainfall  
Data, W80-00330 7B
- TAYLOR, H. E.**  
An Inductive-Coupled Plasma Atomic-Emission  
Spectrometric Method for Routine Water Qual-  
ity Testing, W80-00229 7B
- TAYLOR, M. C.**  
Guidelines for Surface Water Quality, Vol. 1  
Inorganic Chemical Substances Arsenic, W80-00194 5C
- TAYLOR, S. L.**  
Plant Life of the Estuary, W80-00301 2L

- TAYLOR, T. L.**  
Sensitivity of 39 Alaskan Marine Species to  
Cook Inlet Crude Oil and No. 2 Fuel Oil,  
W80-00168 5C
- TEAL, J. M.**  
Denitrification in a Salt Marsh Ecosystem,  
W80-00355 2L
- Nitrogen Fixation by Rhizosphere and Free-  
Living Bacteria in Salt Marsh Sediments,  
W80-00016 2I
- Nutrient Limitation in Salt Marsh Vegetation,  
W80-00039 2I
- TEUTSCH, J.**  
Controls and Remedies for Ground Water -  
Caused Land Subsidence, W80-00389 6E
- THOMANN, R. V.**  
An Analysis of PCB in Lake Ontario Using a  
Size-Dependent Food Chain Model, W80-00216 5A
- THOMAS, J. P.**  
Cl5+Hydrocarbons in the Sediments of the  
New York Bight, W80-00177 5C
- THOMAS, R. L.**  
Organochlorine Insecticides and PCB in Surf-  
icial Sediments (1968) and Sediment Cores (1976)  
from Lake Ontario, W80-00341 5A
- THOMPSON, G. M.**  
Trichlorofluoromethane in Groundwater-A  
Possible Tracer and Indicator of Groundwater  
Age, W80-00096 2F
- TILLEY, L. J.**  
Some Larvae of Diamesinae and Podonominae,  
Chironomidae from the Brooks Range, Alaska,  
with Provisional Key, W80-00218 1A
- TILTON, D. L.**  
The Mineral Content of Sphagnum Fuscum as  
Affected by Human Settlement, W80-00024 2I
- TIMBOL, A. S.**  
Stream Channel Modification in Hawaii. Part A:  
Statewide Inventory of Streams: Habitat Factors  
and Associated Biota, W80-00003 6G
- Stream Channel Modification in Hawaii. Part B:  
Effect of Channelization on the Distribution and  
Abundance of Fauna in Selected Streams,  
W80-00004 6G
- TONARELLI, B.**  
Tritium and Oxygen Profiles in the Eastern  
Mediterranean, W80-00078 5B
- TORSTENSSON, B.-A.**  
Method and Device for Determining the Pore  
Water Pressure in a Soil, W80-00110 2G
- TRAINOR, F. R.**  
Algal Assays for Areas Receiving or Pro-  
grammed to Receive Sewage Effluent,  
W80-00193 5A
- TUCKER, C. S.**  
Emergency Aeration of Fish Ponds,  
W80-00192 8I
- TURNER, J. F. JR.**  
Flood Profiles of the Pithlachascotee River,  
West-Central Florida, W80-00225 2E

- TURNER, R. E.**  
Community Plankton Respiration in a Salt  
Marsh Estuary and the Importance of Macro-  
phytic Leachates, W80-00014 2I
- TUROVSKY, I. S.**  
Fundamental Principles of Selecting the Method  
for Processing Sewage Sediments in Accordance  
with Their Properties, W80-00115 5D
- TYAGI, A. K.**  
Effect of Distillery Waste on Some Freshwater  
Teleosts-Biochemical Studies, W80-00396 5B
- TYSER, J. A.**  
The Pumping of Water from Mines in the Cen-  
tral Witwatersrand, W80-00260 5D
- UENO, F.**  
Direct Observations of Aerosols Attached to  
Falling Snow Crystals, W80-00080 2C
- UMARI, A.**  
Identification of Aquifer Dispersivities in Two-  
Dimensional Transient Groundwater Contami-  
nant Transport: An Optimization Approach,  
W80-00393 2F
- UNGAR, I. A.**  
Halophyte Seed Germination, W80-00326 2I
- VALIELA, I.**  
Denitrification in a Salt Marsh Ecosystem,  
W80-00355 2L
- Nitrogen Fixation by Rhizosphere and Free-  
Living Bacteria in Salt Marsh Sediments,  
W80-00016 2I
- Nutrient Limitation in Salt Marsh Vegetation,  
W80-00039 2I
- VAQUER, A.**  
Adsorption and Accumulation of Pesticides Res-  
idues and Chlorinated Biphenyls in Both Wild  
Aquatic Vegetation and Rice in the Camargue  
Region, (In French), W80-00020 5B
- VARGO, G. A.**  
The Contribution of Ammonia Excreted by  
Zooplankton to Phytoplankton Production in  
Narragansett Bay, W80-00399 5A
- VECCHIOLI, J.**  
Monitoring of Subsurface Injection of Wastes,  
Florida, W80-00222 5B
- VELTING, M.**  
Reuse of Brines in Commercial Cucumber Fer-  
mentations, W80-00128 5D
- Reuse of Fermentation Brines in the Cucumber  
Pickling Industry, W80-00251 5D
- VENEZIANO, D.**  
Systematic Sampling of Gaussian Random Pro-  
cesses and Fields, W80-00089 2F
- VENKATESH, S.**  
Prediction of the Motion of Oil Spills in Canadi-  
an Arctic Waters, W80-00184 5C
- VERMA, S. R.**  
Effect of Distillery Waste on Some Freshwater  
Teleosts-Biochemical Studies, W80-00396 5B

# AUTHOR INDEX

VERMA, S. R.

- Pesticide Induced Haematological Alterations in a Fresh Water Fish *Saccobranchius Fossilis*, W80-00392 5C
- VERMERSCH, J. A.  
Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069 2L
- VOORS, A. W.  
Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G
- VOSLOC, P. B. B.  
Richards Bay Mzingazi Water Purification Works, W80-00268 5F
- WADE, T.  
The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169 5C
- WALDO, A. B.  
The Intergovernmental Tangle Facing Storm-water Control, W80-00061 4D
- WALKER, W.  
The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B
- WALL, D.  
Response of Lake Phytoplankton Communities to In Situ Manipulations of Light Intensity and Colour, W80-00400 5A
- WALL, W. J. JR.  
Control of Salt Marsh *Culicoides* and *Tabanus* Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013 5C
- WALLACE, D. E.  
Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289 2J
- WALSH, G. E.  
Mangroves: A Review, W80-00319 2I
- WARD, S. D.  
Information About Hazardous Waste Management Facilities, W80-00245 5D
- WASENIUS, V.-M.  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- WATSON, A.  
Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160 5C
- WAYMIRE, E. C.  
A Stochastic Kinematic Study of Subsynoptic Space-Time Rainfall, W80-00092 2B
- WEBER, B. A.  
Local Government Response to State-Mandated Land Use Laws, W80-00369 6E
- WEBER, W. J.  
The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D
- WEILER, R. R.  
Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K
- WEISS, E. B.  
Alternative Regimes for the Ocean, W80-00377 6E  
The Managerial Fisheries, W80-00378 6E  
Offshore Oil and Gas Exploitation, W80-00379 6E
- WELLINGS, F. M.  
Virus Consideration in Land Disposal of Sewage Effluents and Sludge, W80-00306 5A
- WELLS, W. G.  
A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
- WELLS, W. J.  
Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D
- WESELY, M. L.  
Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351 2D
- WESTRHEIM, K.  
Petroleum Hydrocarbons in the North Sea, W80-00178 5C
- WESTRICK, J. J.  
Overview of Physical-Chemical Treatment, W80-00098 5D
- WHITE, A. F.  
Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232 2K
- WHITE, I. C.  
Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C
- WHITNEY, L. F.  
Potato Juice Processing, W80-00136 5D
- WIDMER, C. M.  
Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D
- WIEBE, W. J.  
Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I
- WIELGOLASKI, F. E.  
Primary Productivity of Alpine Meadow Communities, W80-00324 2G
- WILHELMSEN, S.  
Petroleum Hydrocarbons in the North Sea, W80-00178 5C
- WILKINSON, B. H.  
Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan, W80-00348 2J
- WILLARD-BOHUSACK, M.  
Plant Life of the Estuary, W80-00301 2L
- WILLIAMS, R.  
Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B
- WILLIS, R.  
Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F
- WILSON, G. E.  
An Effective Wastewater Management Program for a Food Processor, W80-00130 5D
- WILSON, P.  
Planning to Narrow the Implementation Gap, W80-00067 4A
- WITHEROW, J.  
Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143 5D
- WITHEROW, J. L.  
Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119 5D
- WOLF, H. W.  
Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers, W80-00246 5D
- WOLF, P. L.  
The Relationship of Marine Macroinvertebrates to Salt Marsh Plants, W80-00321 2I
- WRIGHT, D. G.  
A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164 5C
- WROBEL, L. C.  
Boundary Element Method for Fluid Flow, W80-00083 8B
- WU, J.  
Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank, W80-00085 2L
- YANG, C. T.  
Velocity Profiles and Minimum Stream Power, W80-00077 2E
- YANG, P. Y.  
Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives, W80-00135 5D
- YARBROUGH, J. D.  
Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, *Ictalurus punctatus*, W80-00395 5A
- YOUNG, D. W.  
The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287 5C
- YOUNG, G. K.  
Non-Point Source Impact and Urban Holding Capacity, W80-00049 4C
- ZAKHARINA, S. B.  
Treatment of Concentrated Waste Waters Containing Oil Emulsions, W80-00111 5D
- ZUBAKOVA, L. B.  
Synthesis of Cationic Polyelectrolytes for Treatment of Natural and Waste Waters, W80-00105 5D
- ZUZEL, J. F.  
Comparing Water Supply Forecast Techniques, W80-00202 2A

# ORGANIZATIONAL INDEX

ies in Two- r Contami- oroach,	2F	<b>AGRICULTURAL RESEARCH ORGANIZATION, BET DAGAN (ISRAEL). INST. OF SOILS AND WATER.</b> Field Test of Solution Flow Models in a Heterogeneous Irrigated Cropped Soil, W80-00091	2G	<b>ARIZONA UNIV., TUCSON. SCHOOL OF RENEWABLE NATURAL RESOURCES.</b> Solar Radiation as Indexed by Clouds for Snow-melt Modeling, W80-00292	2C	<b>BOWDOIN COLL., BRUNSWICK, ME. MARINE RESEARCH LAB.</b> Hydrocarbon Distribution and Weathering Characteristics at a Tropical Oil Spill Site, W80-00188	5C
nt Program	5D	<b>ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.</b> Modeling the Association of Petroleum Hydrocarbons and Sub-Arctic Sediments, W80-00176	5C	<b>ARIZONA UNIV., TUCSON. SCHOOL OF RENEWABLE NATURAL RESOURCES; AND WISCONSIN UNIV.-MADISON. DEPT. OF FORESTRY.</b> Action Programs for Water Yield Improvement on Arizona's Watersheds: Political Constraints to Implementation, W80-00275	3B	<b>BOYLE ENGINEERING CORP., PHOENIX, AZ.</b> Analysis of Wastewater Land Treatment Systems in the Phoenix Urban Area, W80-00272	5D
ation Gap,	4A	<b>ALEXANDRIA UNIV. (EGYPT). HIGHER INST. OF PUBLIC HEALTH.</b> Water Reuse in Poultry Processing: Case Study in Egypt, W80-00143	5D	<b>ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.</b> The Compartmented Reservoir: Efficient Water Storage in Flat Terrain Areas of Arizona, W80-00277	8A	<b>BRIDGEWATER STATE COLL., MA. DEPARTMENT OF BIOLOGY.</b> Control of Salt Marsh Culicoides and Tabanus Larvae in Small Plots with Granular Organophosphorus Pesticides, and the Direct Effect on Other Fauna, W80-00013	5C
Case Study	5D	<b>ANALYTIC SCIENCES CORP., READING, MA.</b> A Minimum-Cost Surveillance Plan for Water Quality Trend Detection in Lake Michigan, W80-00213	6A	<b>ARMY ENGINEER DISTRICT, PITTSBURGH, PA.</b> Emergent Aquatic Plants in the Upper Ohio River and Major Navigable Tributaries, West Virginia and Pennsylvania, W80-00029	2I	<b>BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF GEOLOGICAL SCIENCES.</b> Stochastic Analysis of Steady State Groundwater Flow in a Bounded Domain 1. One-Dimensional Simulations, W80-00070	2F
ic Lagoon	5D	<b>ARGONNE NATIONAL LAB., IL.</b> Heat Transfer Through the Thermal Skin of a Cooling Pond with Waves, W80-00351	2D	<b>ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS. ENVIRONMENTAL EFFECTS LAB.</b> Physical and Engineering Properties of Hazardous Industrial Wastes and Sludges, W80-00243	8G	<b>BRITISH METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).</b> Rainfall Measurement by Radar, W80-00329	7B
Excessive	5D	<b>ARIZONA STATE LAND DEPT., PHOENIX.</b> The Effects on Water Quality by Mining Activity in the Miami, Arizona Region, W80-00287	5C	<b>ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, NH.</b> A Dynamic Thermodynamic Sea Ice Model, W80-00084	2C	<b>BRITISH PETROLEUM CO. LTD., LONDON (ENGLAND).</b> Applications of Ecosystem Analysis to Oil Spill Impact, W80-00162	5C
invertebrates	2I	<b>ARIZONA STATE UNIV., TEMPE. DEPT. OF ENGINEERING.</b> Heavy Metals and Wastewater Reuse, W80-00282	5B	<b>ATLANTIC RICHFIELD CO., LOS ANGELES, CA.</b> Ecological Impacts of Oil Spill Cleanup: Are They Significant, W80-00163	5C	<b>BRITISH PETROLEUM TRADING LTD., LONDON (ENGLAND); AND BRITISH PETROLEUM CO. LTD., SUNBURY-ON-THAMES (ENGLAND). RESEARCH CENTRE.</b> Problems in Ecological Monitoring in Port Valdez, Alaska, W80-00189	5C
Oil Spill in	5C	<b>ARIZONA STATE WATER AND SEWER DEPT., TUCSON.</b> Hydrologic Factors Affecting Groundwater Management for the City of Tucson, Arizona, W80-00269	4B	<b>ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO); AND ATMOSPHERIC DYNAMICS CORPORATION, ELMIRA, ONTARIO.</b> Prediction of the Motion of Oil Spills in Canadian Arctic Waters, W80-00184	5C	<b>BRUNSWICK JUNIOR COLL., GA.</b> Probable Agents for the Formation of Detritus from the Halophyte, Spartina Alterniflora, W80-00036	2I
Flow,	8B	<b>Tucson's Tools for Demand Management,</b> W80-00270	6B	<b>AUBURN UNIV., AL. DEPT. OF FISHERIES AND ALLIED AQUACULTURES.</b> Emergency Aeration of Fish Ponds, W80-00192	8I	<b>C-E BAUER, SPRINGFIELD, OH.</b> Application of Fine Screens in the Treatment of Food Processing Wastewater, W80-00126	5D
ecay of Mi- e Structures	2L	<b>Arizona Groundwater Law Reform - An Urban Perspective,</b> W80-00271	6E	<b>AUCKLAND UNIV. (NEW ZEALAND). DEPT. OF THEORETICAL AND APPLIED MECHANICS.</b> Stochastic Optimization of a Water Supply System, W80-00397	6A	<b>CALGARY UNIV. (ALBERTA).</b> Applying Probabilistic Water Quality Standards in River Basin Water Quality Optimization Models, W80-00342	6A
ream Power,	2E	<b>ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.</b> Comment on 'Value of Information in Reservoir Optimization' by V. Klemes, W80-00147	6A	<b>BATTELLE PACIFIC NORTHWEST LAB., SEQUIM, WA. MARINE RESEARCH LAB.</b> Comparative Uptake of Naphthalenes from Water and Oiled Sediment by Benthic Amphipods, W80-00171	5C	<b>CALIFORNIA UNIV., BERKELEY. LAWRENCE BERKELEY LAB.</b> The Significance of the Storage Parameter in Saturated-Unsaturated Groundwater Flow, W80-00094	2F
Processing reatment Al-	5D	<b>Ephemeral Flow and Water Quality Problems: A Case Study of the San Pedro River in South-eastern Ariz.,</b> W80-00281	2E	<b>BOEING COMMERCIAL AIRPLANE CO., SEATTLE, WA.</b> Aircraft Industry Wastewater Recycling, W80-00255	5D	<b>CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF GEOLOGICAL SCIENCES.</b> The Fluvial System: Selected Observations, W80-00019	2E
ng Exposure Catfish, Icta-	5A	<b>Legal Aspects of Urban Runoff Development,</b> W80-00293	6E	<b>BOSTON UNIV. MARINE PROGRAM, WOODS HOLE, MA. MARINE BIOLOGICAL LAB.</b> Nutrient Limitation in Salt Marsh Vegetation, W80-00039	2I	<b>Beach and Salt Marsh Vegetation of the North American Pacific Coast,</b> W80-00031	2I
ining Activi-	5C	<b>ARIZONA UNIV., TUCSON. DEPT. OF SOILS, WATER AND ENGINEERING; AND OKLAHOMA STATE UNIV., STILLWATER. SOIL TESTING LAB.</b> Nitrogen Removal from Secondary Effluent Applied to a Soil-Turf Filter, W80-00274	5F				
ban Holding	4C	<b>ARIZONA UNIV., TUCSON. DEPT. OF SYSTEMS AND INDUSTRIAL ENGINEERING.</b> Water Quality of Runoff from Surface Mined Lands in Northern Arizona, W80-00288	5B				
Waters Con-	5D	<b>ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES.</b> Management Alternatives for Santa Cruz Basin Groundwater, W80-00296	6A				
tes for Treat-	5D						
r Techniques,	2A						

**ORGANIZATIONAL INDEX**  
**CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).**

**CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO).**

Polychlorinated Biphenyls and Organochlorine Pesticides in Great Lakes Precipitation, W80-00086 5A

Diagenesis of Organic Matter in the Sediments of Lakes Ontario, Erie, and Huron, W80-00088 2K

Hypolimnetic Oxygen Depletion in Central Lake Erie: Has There Been Any Change, W80-00197 2H

Assessment of Water Quality Simulation Capability for Lake Ontario, W80-00199 2A

Mathematical Modeling of Phosphorus Dynamics Through Integration of Experimental Work and System Theory, W80-00208 2H

**CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).**

Rate of Loss of Ammonia from Water to the Atmosphere, W80-00075 2K

**CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF GEOLOGY.**

Surficial Sediments of Saldanha Bay and Langebaan Lagoon, W80-00012 2J

**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, ARLES (FRANCE). CENTRE ECOLOGIE CAMARGUE.**

Adsorption and Accumulation of Pesticides Residues and Chlorinated Biphenyls in Both Wild Aquatic Vegetation and Rice in the Camargue Region, (In French), W80-00020 5B

**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, MARSEILLE (FRANCE). LAB. DE BOTANIQUE.**

Contribution to the Study of Some Bryoassociations of the Subalpine Zone in the Southeast of France (Contribution à l'étude de Quelques Bryoassociations de l'étage Subalpine Dans le Sud-est de la France), W80-00006 2I

**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, MONTPELLIER (FRANCE). CENTRE D'ETUDES PHYTOSOCIOLOGIQUES ET ECOLOGIQUES LOUIS-EMBERGER.**

Comparative Ecological Requirements of a Perennial and an Annual Salicornia Species: Germination and Growth During the Early Stages of Development, (In French), W80-00010 2I

**CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, MONTPELLIER (FRANCE). DEPT. DE PHYSIOLOGIE ECOLOGIQUE.**

Growth and Salt Accumulation in Two Annual Species of Salicornia from the Mediterranean Coast, (In French), W80-00018 2I

**CENTRE OCEANOLOGIQUE DE BRETAGNE, BREST (FRANCE).**

Ecophysiological Effects of Oil Spills from Amoco Cadiz on Pelagic Communities--Preliminary Results, W80-00152 5C

Occurrence of Oil in Offshore Bottom Sediments at the Amoco Cadiz Oil Spill Site, W80-00153 5C

**CLARKSON COLL. OF TECHNOLOGY, POTSDAM, NY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.**

Water Column Death and Decomposition of Phytoplankton: An Experimental and Modeling Review, W80-00206 2H

**COAST GUARD RESEARCH AND DEVELOPMENT CENTER, GROTON, CT.**

Oil Spill Forecasting--Where Is It Going, W80-00181 5C

**COAST GUARD, WASHINGTON, DC; AND ARCTEC, INC., COLUMBIA, MD.**

Cold Regions Spill Response, W80-00158 5C

**CONNECTICUT COLL., NEW LONDON.**

Plant Life of the Estuary, W80-00301 2L

Estuarine Animals, W80-00302 2L

**CONNECTICUT UNIV., STORRS. INST. OF WATER RESOURCES.**

Algal Assays for Areas Receiving or Programmed to Receive Sewage Effluent, W80-00193 5A

**CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.**

Identification of Aquifer Dispersivities in Two-Dimensional Transient Groundwater Contaminant Transport: An Optimization Approach, W80-00393 2F

**CORNELL UNIV., ITHACA, NY. SECTION OF ECOLOGY AND SYSTEMATICS.**

Biogeochemistry of a Forested Ecosystem, W80-00328 4C

**CORPS OF ENGINEERS, WASHINGTON, DC.**

Weed Control Methods for River Basin Management, W80-00323 2I

**CULP/WESNER/CULP, EL DORADO HILLS, CA.**

Field Manual for Performance Evaluation and Troubleshooting at Municipal Wastewater Treatment Facilities, W80-00253 5D

**D.A.V. COLL., MUZAFFARNAGAR (INDIA). DEPT. OF ZOOLOGY.**

Pesticide Induced Haematological Alterations in a Fresh Water Fish Saccobranchus Fossilis, W80-00392 5C

Effect of Distillery Waste on Some Freshwater Teleosts-Biochemical Studies, W80-00396 5B

**DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). DEPT. OF OCEANOGRAPHY.**

Bubble Populations and Spectra in Coastal Waters: A Photographic Approach, W80-00352 2L

**DELAWARE UNIV., NEWARK. COLL. OF MARINE STUDIES.**

Temporal Rates of Growth and Decay of Microscopic and Macroscopic Surface Structures in a Wind-Wave Tank, W80-00085 2L

**DELAWARE UNIV., NEWARK. DEPT. OF PLANT SCIENCE.**

Marsh Soils of the Atlantic Coast, W80-00320 2G

**DENVER UNIV., CO. DEPT. OF BIOLOGICAL SCIENCES.**

Fungal Conversion of Carbohydrate Wastes to Animal Feed Protein-Vitamin Supplements, W80-00141 5D

**DEPARTMENT OF COMMERCE, WASHINGTON, DC.**

Report to the Congress on Ocean Pollution Over Fishing, and Offshore Development (October 1976 Through September 1977). W80-00381 6E

**DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND).**

The Compressibility and Hydraulic Diffusivity of a Water-Steam Flow, W80-00090 2G

**DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). INLAND WATERS DIRECTORATE.**

A Water Quality Economic Index, W80-00346 6B

**DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). WATER QUALITY BRANCH.**

Guidelines for Surface Water Quality, Vol. 1 Inorganic Chemical Substances Arsenic, W80-00194 5C

Water Quality Sourcebook. A Guide to Water Quality Parameters, W80-00200 2A

**DEPARTMENT OF THE ENVIRONMENT, OTTAWA (ONTARIO). WATER RESOURCES BRANCH.**

Surface Water Data Manitoba 1978. W80-00195 4A

Surface Water Data Yukon and Northwest Territories 1978. W80-00196 4A

**EAST CENTRAL OKLAHOMA STATE UNIV., ADA. SCHOOL OF ENVIRONMENTAL SCIENCE.**

Treatment of Packerhouse Wastewater by Sand Filtration, W80-00129 5D

**EAST RAND PROPRIETARY MINES, LTD., BOKSBURG (SOUTH AFRICA).**

The Pumping of Water from Mines in the Central Witwatersrand, W80-00260 5D

**ENERGY AND ENVIRONMENTAL ANALYSIS, INC., BOSTON, MA.**

Cost Effective Approach for Combined Storm and Sewer Clean-Up, W80-00055 4A

**ENERGY RESOURCES CO., INC., CAMBRIDGE, MA.**

A Chemical Assessment of the Present Levels and Sources of Hydrocarbon Pollutants in the Georges Bank Region, W80-00157 5B

**ENVIRONMENTAL CONTROL CONSULTANCY SERVICES LTD., LONDON (ENGLAND).**

The Economic Implications of Water Re-Use, W80-00257 5D

**ENVIRONMENTAL PROTECTION AGENCY, NEW YORK.**

Impact of Dispersant Use During the Brazilian Marina Incident, W80-00156 5C

**ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. EFFLUENT GUIDELINES DIV.**

Status of EPA's Effluent Guidelines for the Food Industry, W80-00117 6E

**ORGANIZATIONAL INDEX**  
**GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.**

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF RESEARCH AND DEVELOPMENT.	EXXON RESEARCH AND ENGINEERING CO., FLORHAM PARK, NJ.	GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.; AND
Considerations in Characterization of Urban Runoff for PL 92-500 Section 208 Planning, W80-00045	The Restoration of Oiled Shorelines by the Proper Use of Chemical Dispersants, W80-00159	GEOLOGICAL SURVEY, MONTGOMERY, AL. WATER RESOURCES DIV.; AND
4A	5C	GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.
Physical-Chemical Treatment of Wastewaters from the Petroleum Refining-Petrochemical Industry, W80-00106	FISH AND WILDLIFE SERVICE, LAUREL, MD. MIGRATORY BIRD AND HABITAT RESEARCH LAB.	Backwater at Bridges and Densely Wooded Flood Plains, Tallahala Creek at Waldrup, Mississippi, W80-00241
5D	2I	6A
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF SOLID WASTE.	FISHERIES AND MARINE SERVICE, ST. JOHN'S (NEWFOUNDLAND); AND MEMORIAL UNIV. OF NEWFOUNDLAND, ST. JOHN'S.	GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Information About Hazardous Waste Management Facilities, W80-00245	Are Petroleum Hydrocarbons an Important Source of Mutagens in the Marine Environment, W80-00165	Water Analysis, W80-00217
4A	5C	1A
ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. WATER PLANNING DIV.	FISHERIES AND MARINE SERVICE, WINNIPEG (MANITOBA).	GEOLOGICAL SURVEY, LAWRENCE, KS. WATER RESOURCES DIV.
Best Management Practices, W80-00044	A Plan for Scientific Response to an Oil Spill in the Beaufort Sea, W80-00164	Guidelines for the Use of Structural Versus Regression Analysis in Geomorphic Studies, W80-00224
4A	5C	7B
Land Management Techniques for Stormwater Control in Developed Urban Areas, W80-00052	FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF BIOLOGICAL SCIENCE.	GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
4C	Correlation of Apalachicola River Floodplain Tree Communities with Water Levels, Elevation, and Soils, W80-00041	Water Resources Data for Nebraska, Water Year 1978, W80-00234
4D	2I	7C
The Intergovernmental Tangle Facing Stormwater Control, W80-00061	FLOW RESEARCH CO., KENT, WA.	GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
6E	Effects of an Oil Slick on Wind Waves, W80-00183	Some Larvae of Diamesinae and Podonominae, Chironomidae from the Brooks Range, Alaska, with Provisional Key, W80-00218
ENVIRONMENTAL RESEARCH LAB., GULF BREEZE, FL.	FOX (F.M.) AND ASSOCIATES, INC., SPOKANE, WA.	1A
Effects of Malathion on Microorganisms of an Artificial Salt-Marsh Environment, W80-00303	Use of Digital Models to Manage Ground Water, W80-00252	Corrosion and Scale-Formation Properties of Geopressured Geothermal Waters from the Northern Gulf of Mexico Basin, W80-00219
2I	2F	1A
ENVIRONMENTAL RESEARCH LAB., GULF BREEZE, FL; AND CORVALLIS ENVIRONMENTAL RESEARCH LAB., OR. ASSOCIATE LAB.	FRANKLIN PIERCE LAW CENTER, CONCORD, NH.	Data Compilation of Periphyton Colonized on Artificial Substrates Placed in the Sacramento and Feather Rivers, California, 1975, W80-00223
Mangroves: A Review, W80-00319	Preliminary Analysis of Legal Obstacles and Incentives to the Development of Low-Head Hydroelectric Power in the Northeastern United States, W80-00363	6G
2I	6E	Two-Dimensional and Three-Dimensional Digital Flow Models for the Salinas Valley Ground-Water Basin, California, W80-00238
ENVIRONMENTAL RESEARCH LAB., NARRAGANSETT, RI.	GEOLOGICAL SURVEY, ANCHORAGE, AK. WATER RESOURCES DIV.	2A
Effects of No. 2 Fuel Oil on Chemically-Evoked Feeding Behavior of the Mud Snail, Ilyanassa Obsoleta, W80-00174	Hydrologic Reconnaissance of Western Arctic Alaska, 1976 and 1977, W80-00233	GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV. AND OAK RIDGE NATIONAL LAB., TN.
5C	1A	Bioaccumulation and Toxicity of Heavy Metals and Related Trace Elements, W80-00237
ENVIRONMENTAL RESEARCH LABS., GULF BREEZE, FL.	GEOLOGICAL SURVEY, BATON ROUGE, LA. WATER RESOURCES DIV.	5C
Effects of Ground Applications of Malathion on Saltmarsh Environments in Northwestern Florida, W80-00025	Ground-Water Resources of Washington Parish, Louisiana, W80-00227	GEOLOGICAL SURVEY, PORTLAND, OR. WATER RESOURCES DIV.
5C	2F	Ground-Water Data in the Baker County-Northern Malheur County Area, Oregon, W80-00226
EPIDEMIOLOGY RESEARCH CENTER, TAMPA, FL. DEPT. OF HEALTH AND REHABILITATIVE SERVICES.	GEOLOGICAL SURVEY, DENVER, CO.; AND EDINBURG UNIV. (SCOTLAND). GRANT INST. OF GEOLOGY.	2F
Virus Consideration in Land Disposal of Sewage Effluents and Sludge, W80-00306	Non-Uniform Vertical Distribution of Fine Sediment in the Amazon River, W80-00220	GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
5A	2J	United States Geological Survey Yearbook, Fiscal Year 1978, W80-00236
ESTABLISSEMENTS KUHLMANN, PARIS (FRANCE). PRODUITS CHIMIQUES.	GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.	7C
Scale-Inhibiting Compositions for Aqueous Solutions, W80-00005	Azomethine H Colorimetric Method for Determining Dissolved Boron in Water, W80-00221	GEOLOGICAL SURVEY, SALT LAKE CITY, UT. WATER RESOURCES DIV.
5G	1B	Developing a State Water Plan, Ground-Water Conditions in Utah, Spring of 1979, W80-00230
ESVELT ENVIRONMENTAL ENGINEERING, SPOKANE, WA.	An Inductive-Coupled Plasma Atomic-Emission Spectrometric Method for Routine Water Quality Testing, W80-00229	2F
Effluent Polishing and Wastewater Reuse at Snokist Growers Cannery, W80-00118	5D	GEOLOGICAL SURVEY, ST. PAUL, MN. WATER RESOURCES DIV.
5D	7B	Water Resources of the Zumbro River Watershed, Southeastern Minnesota, W80-00240
EUTEK, INC., SACRAMENTO, CA.	Application of Geochemical Kinetic Data to Ground-Water Systems: A Tuffaceous-Rock System in Southern Nevada, W80-00232	7C
An Effective Wastewater Management Program for a Food Processor, W80-00130	5D	6K
6E		GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
		Flood Elevations for the Sooes River at Proposed Fish Hatchery, Clallam County, Washington - A Surface-Water Site Study, W80-00231
		8I

**ORGANIZATIONAL INDEX**  
**GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.**

- GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.**  
Monitoring of Subsurface Injection of Wastes, Florida, W80-00222 5B  
Flood Profiles of the Pithlachascotee River, West-Central Florida, W80-00225 2E
- GEOLOGICAL SURVEY, TUCSON, AZ. WATER RESOURCES DIV.**  
Maps Showing Ground-Water Conditions in the Lower Santa Cruz Area, Pinal, Pima, and Maricopa Counties, Arizona-1977, W80-00239 7C
- GEOLOGICAL SURVEY, UNIVERSITY, AL. WATER RESOURCES DIV.**  
Water Resources Data for Alabama, Water Year 1978, W80-00235 7C
- GEORGIA UNIV., ATHENS.**  
Sea Changes and the American Republic, W80-00383 6E
- GEORGIA UNIV., ATHENS. DEPT. OF BOTANY.**  
Seasonal Patterns of CO<sub>2</sub> and Water Vapor Exchange of *Juncus Roemerianus* Scheele in a Georgia Salt Marsh, W80-00023 2I
- GEORGIA UNIV., ATHENS. DEPT. OF MICROBIOLOGY.**  
Resistance of the Microbial Community Within Salt Marsh Soils to Selected Perturbations, W80-00314 2I
- GEORGIA UNIV., BRUNSWICK. MARINE RESOURCES EXTENSION CENTER.**  
An Evaluation of Methods for Estimating the Net Aerial Primary Productivity of Estuarine Angiosperms, W80-00017 2I
- GEORGIA UNIV., SAPELO ISLAND. MARINE INST.**  
Mathematical Modeling-Spartina, W80-00034 2I  
Remote Sensing as a Tool for Studying the Ecology of Halophytes, W80-00037 7B  
Relationship of Vertebrates to Salt Marsh Plants, W80-00038 2I  
Sampling Macro-Organic Matter Profiles in Salt Marsh Plant Root Zones, W80-00309 2I  
The Relationship of Marine Macroinvertebrates to Salt Marsh Plants, W80-00321 2I
- GERAGHTY AND MILLER, INC., PORT WASHINGTON, NY.**  
The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, W80-00248 5B
- GKY AND ASSOCIATES, ALEXANDRIA, VA.**  
Non-Point Source Impact and Urban Holding Capacity, W80-00049 4C
- HARVARD UNIV., CAMBRIDGE, MA. DIV. OF APPLIED SCIENCES; AND BERMUDA BIOLOGICAL STATION, FERRY REACH.**  
Hydrocarbons in Sediments from the Edge of the Bermuda Platform, W80-00175 5C
- HAWAII COOPERATIVE FISHERY RESEARCH UNIT, HONOLULU.**  
Stream Channel Modification in Hawaii. Part A: Statewide Inventory of Streams: Habitat Factors and Associated Biota, W80-00003 6G  
Stream Channel Modification in Hawaii. Part B: Effect of Channelization on the Distribution and Abundance of Fauna in Selected Streams, W80-00004 6G
- HAWAII UNIV. AT MANOA, HONOLULU.**  
Evaluation of Instant Noodles Processing Wastewater Characteristics and Treatment Alternatives, W80-00135 5D
- HAWAII UNIV., HONOLULU. JOINT INST. FOR MARINE AND ATMOSPHERIC RESEARCH.**  
Ridge Regression-Time Extrapolation Applied to Hawaiian Rainfall Normals, W80-00350 2B
- HOKKAIDO UNIV., SAPPORO (JAPAN). DEPT. OF GEOPHYSICS.**  
Direct Observations of Aerosols Attached to Falling Snow Crystals, W80-00080 2C
- IDAHO UNIV., MOSCOW. DEPT. OF CHEMICAL ENGINEERING.**  
Single Cell Protein from Food Wastes by the Deep Tank Process, W80-00134 5D
- INDIANA UNIV. AT BLOOMINGTON. DEPT. OF GEOLOGY.**  
Trichlorofluoromethane in Groundwater-A Possible Tracer and Indicator of Groundwater Age, W80-00096 2F
- INSTITUT HYGIENY A EPIDEMIOLOGIE, PRAGUE (CZECHOSLOVAKIA). DEPT. OF GENERAL PUBLIC HYGIENE.**  
The Uptake of 226Ra by Planktonic Algae Under Conditions of Continuous Cultivation, W80-00394 5A
- INSTITUTE OF HYDROLOGY, WALLINGFORD (ENGLAND).**  
Real-Time Conversion of Rainfall to Runoff for Flow Forecasting in the River Dee, W80-00334 2E
- INSTITUTE OF MARINE RESEARCH, BERGEN (NORWAY).**  
Petroleum Hydrocarbons in the North Sea, W80-00178 5C
- INSTITUTE OF MARINE RESEARCH, BERGEN (NORWAY); AND NORDIC COUNCIL FOR MARINE BIOLOGY, BLOMSTERDALEN (NORWAY).**  
Response of a Subtidal Sediment Community to Low Levels of Oil Hydrocarbons in a Norwegian Fjord, W80-00179 5C
- INTERNATIONAL TANKER OWNERS POLLUTION FEDERATION LTD., LONDON (ENGLAND).**  
Ten-Year Overview of Oil Spill Clean-Up at Sea, W80-00155 5C
- JOHANNESBURG CITY COUNCIL (SOUTH AFRICA).**  
Sewage Treatment - The State of the Art, W80-00261 5D
- JOHNSON AND ANDERSON, INC., PONTIAC, MI.**  
Economic Return on Pollution Control Expenditures for the Pickled Food Industry, W80-00131 5D
- JORDAN (EDWARD C.), INC., PORTLAND, ME.**  
Dissolved Air Flotation Treatment of Seafood Processing Wastes - An Assessment, W80-00123 5D
- JYVASKYLA UNIV. (FINLAND). DEPT. OF CHEMISTRY.**  
Toxicity of 4-Chloro-O-Cresol to Fish. Light Microscopy and Chemical Analysis of the Tissue, W80-00391 5A
- KANSAS STATE UNIV., MANHATTAN. DEPT. OF CHEMISTRY.**  
Silica and Ash in the Salt Marsh Rush, *Juncus Roemerianus*, W80-00325 2I
- KIEL UNIV. (GERMANY, F.R.). INST. FUER MEERESKUNDE.**  
Lagrangian and Eulerian Measurements of Horizontal Mixing in the Baltic, W80-00359 5B
- KRAMER, CHIN, AND MAYO, INC., SEATTLE, WA.**  
Salmon Processing Wastewater Treatment, W80-00140 5D
- LABORATORIO DI GEOLOGIA NUCLEARE, PISA (ITALY).**  
Tritium and Oxygen Profiles in the Eastern Mediterranean, W80-00078 5B
- LITTLE (ARTHUR D.) INC., CAMBRIDGE, MA.**  
Economic Assessment of Potential Hazardous Waste Control Guidelines for the Inorganic Chemicals Industry, W80-00249 6B
- LITTLE (ARTHUR D.), INC., CAMBRIDGE, MA; AND COAST GUARD, WASHINGTON, DC.**  
The Survival of Oil Slicks on the Ocean as a Function of Sea State Limit, W80-00190 5C
- LOCKHEED PALO ALTO RESEARCH LABS., CA.**  
Development of Microwave Plasma Detoxification Process for Hazardous Wastes. Phase 1, W80-00244 5D
- LOUISIANA STATE UNIV., BATON ROUGE. CENTER FOR WETLAND RESOURCES.**  
Community Plankton Respiration in a Salt Marsh Estuary and the Importance of Macrophytic Leachates, W80-00014 2I
- LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF FOOD SCIENCE.**  
Recovery and Application of Organic Wastes from the Louisiana Shrimp Canning Industry, W80-00137 5D
- LOUISIANA STATE UNIV. MEDICAL CENTER, NEW ORLEANS. DEPT. OF PREVENTIVE MEDICINE.**  
Relationships Between Respiratory Cancer and Wetlands Residency in Louisiana, W80-00015 6G
- LOUVAIN UNIV. (BELGIUM).**  
A Telemetry System Working Through the Public Telephone Network, W80-00339 2E
- MANHATTAN COLL., BRONX, NY. DEPT. OF ENVIRONMENTAL ENGINEERING AND SCIENCE.**  
An Analysis of PCB in Lake Ontario Using a Size-Dependent Food Chain Model, W80-00216 5A

**ORGANIZATIONAL INDEX**  
**NATIONAL MARINE FISHERIES SERVICE, AUKE BAY, AK. NORTHWEST AND ALASKA**

LAND, of Seafood 5D	<b>MARINE BIOLOGICAL LAB., WOODS HOLE, MA. BOSTON UNIV. MARINE PROGRAM.</b> Denitrification in a Salt Marsh Ecosystem, W80-000355 2L	<b>MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF RESOURCE DEVELOPMENT.</b> Empirical Lake Models for Phosphorus: Development, Applications, Limitations and Uncertainty, W80-00212 2H	<b>MISSISSIPPI STATE UNIV., MISSISSIPPI STATE.</b> The Occurrence of 'White Eye Syndrome' in Shrimp ( <i>Penaeus aztecus</i> ), W80-00166 5C
PT. OF Fish. Light sis of the 5A	<b>MARSHALL UNIV., HUNTINGTON, WV. DEPT. OF BIOLOGICAL SCIENCES.</b> Floristics of the Middle Mississippi River Sand and Mud Flats, W80-00028 2I	<b>MICHIGAN UNIV., ANN ARBOR.</b> Nitrogen Dynamics and Modeling in a Freshwater Wetland, W80-00327 2K	<b>MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.</b> A Tidal Simulation System for Estuarine Ecosystem Research, W80-00191 5C
AN, DEPT. ush, Juncus 2I	<b>MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.</b> Systematic Sampling of Gaussian Random Processes and Fields, W80-00089 2F	<b>MICHIGAN UNIV., ANN ARBOR. COLL. OF ENGINEERING.</b> The Role of Activated Carbon in Physico-Chemical Treatment, W80-00102 5D	<b>MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.</b> Tissue Enzyme Activities Following Exposure to Dietary Mirex in the Channel Catfish, <i>Ictalurus punctatus</i> , W80-00395 5A
T. FUER nts of Hori- 5B	<b>MASSACHUSETTS UNIV., AMHERST.</b> Coastal Hazards and National Policy: A Jury-Rig Approach, W80-00370 6E	<b>MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.</b> Influence of Nearshore Till Lithology on Lateral Variations in Coastline Recession Rate Along Southeastern Lake Michigan, W80-00348 2J	<b>MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF ZOOLOGY.</b> Caloric, Elemental, and Nutritive Changes in Decomposing <i>Juncus roemerianus</i> Leaves, W80-00307 2I
ment, 5D	<b>MASSACHUSETTS UNIV., AMHERST. DEPT. OF BOTANY.</b> The Role of Overwash and Inlet Dynamics in the Formation of Salt Marshes on North Carolina Barrier Islands, W80-00035 2L	<b>MICHIGAN UNIV., ANN ARBOR. GREAT LAKES AND MARINE WATERS CENTER.</b> Zooplankton Grazing in Simulation Models: The Role of Vertical Migration, W80-00207 2H	<b>MISSISSIPPI UNIV., UNIVERSITY. DEPT. OF CIVIL ENGINEERING.</b> A Stochastic Kinematic Study of Subsynchronous Space-Time Rainfall, W80-00092 2B
CLEARE, the Eastern 5B	<b>MASSACHUSETTS UNIV., AMHERST. DEPT. OF FOOD AND AGRICULTURAL ENGINEERING.</b> Potato Juice Processing, W80-00136 5D	<b>MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). DEPT. OF GEOLOGICAL ENGINEERING.</b> Diffusion of Dissolved Gas in Consolidating Porous Media, W80-00095 2F	<b>MON-TER-VAL, INC., MONTREAL (QUEBEC).</b> Soil Investigations: Richelieu Dam Project, St. John's Shoal, St. John, St. John's County, Quebec. W80-00042 8D
BRIDGE, Hazardous e Inorganic 6B	<b>MCGILL UNIV., MONTREAL (QUEBEC).</b> Comparison of Finite Element and Finite Difference Methods in Thermal Discharge Investigations, W80-00082 5B	<b>MILAN UNIV. (ITALY). IST. DI ELETTROTECNICA ED ELETTRONICA; AND CENTRO TEORIA DEI SISTEMI, MILAN (ITALY).</b> Real-Time Predictor Versus Synthetic Hydrology for Sequential Reservoir Management, W80-00361 6A	<b>MUNICIPAL ENVIRONMENTAL RESEARCH LAB., CINCINNATI, OH.</b> A Cost-Effective Swirl Combined Sewer Overflow Regulator/Solids-Separator, W80-00057 4A
BRIDGE, NGTON, Ocean as a 5C	<b>MCMASTER UNIV., HAMILTON (ONTARIO).</b> Predictive Water Quality Models for the Great Lakes: Some Capabilities and Limits, W80-00211 2H	<b>MINNESOTA UNIV.-DULUTH.</b> Peatland Policy Study, W80-00317 6E	<b>MUNICIPALITY OF METROPOLITAN SEATTLE-METRO, WA.</b> Planning to Narrow the Implementation Gap, W80-00067 4A
CH LABS., Detoxifica- es. Phase I, 5D	<b>Utilization of Oxygen Models in Environmental Impact Analysis,</b> W80-00312 5C	<b>MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL ENGINEERING.</b> Velocity Profiles and Minimum Stream Power, W80-00077 2E	<b>NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE, WASHINGTON, DC.</b> Compensating States and the Federal Government for Damages to Natural Resources Resulting from Oil Spills, W80-00387 6E
ROUGE. CES. in a Salt e of Macro- 2I	<b>METCALF AND EDDY, INC., BOSTON, MA.</b> Factors for Predicting Commercial Water Use, W80-00203 6D	<b>MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF ECOLOGY AND BEHAVIORAL BIOLOGY.</b> The Mineral Content of Sphagnum Fuscum as Affected by Human Settlement, W80-00024 2I	<b>NATIONAL CANNERS ASSOCIATION, BERKELEY, CA.</b> Tomato Cleaning, Water Recycle and Mud Dewatering, W80-00120 5D
W ROUGE. anic Wastes ng Industry, 5D	<b>METCALF AND EDDY, INC., PALO ALTO, CA.</b> Impact of CSO/SSD on Water Quality, W80-00048 4A	<b>MINNESOTA UNIV., ST. PAUL. COLL. OF FORESTRY.</b> Regional Analysis of Economic Activity, Resource Management and Lake Eutrophication: A Case Study of Itasca County, Minnesota, W80-00254 5C	<b>NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).</b> Current Technology and Research on Re-Use of Effluents, W80-00258 5D
AL OF Cancer and 6G	<b>Applications of Stormwater Management Models,</b> W80-00051 4A	<b>MINNESOTA UNIV., ST. PAUL. DEPT. OF AGRICULTURAL ENGINEERING.</b> The Treatment and Disposal of Wastewater from Dairy Processing Plants, W80-00144 5D	<b>Operation and Control of Water Purification Plants, Part II,</b> W80-00262 5E
Through the 2E	<b>Collection System Control,</b> W80-00056 4A	<b>MINNESOTA UNIV., ST. PAUL. DEPT. OF ANIMAL SCIENCE.</b> Nutritive Value of Dried or Ensiled Aquatic Plants. I. Chemical Composition, W80-00298 2I	<b>NATIONAL INST. OF SCIENTIFIC RESEARCH (QUEBEC).</b> Effect of the Percentage and Distribution of Forested Areas on Snow-Melt Runoff (Effet du Pourcentage et de la Distribution des Surfaces Boisees sur les Crues de Fonte de Neige), W80-00072 2C
Y. DEPT. OF G AND 5A	<b>MICHIGAN DEPT. OF CONSERVATION, LANSING. ROSE LAKE WILDLIFE EXPERIMENT STATION.</b> Effects of a Drawdown on a Waterfowl Impoundment, W80-00315 2H	<b>Nutritive Value of Dried or Ensiled Aquatic Plants. II. Digestibility by Sheep,</b> W80-00299 2I	<b>NATIONAL MARINE FISHERIES SERVICE, AUKE BAY, AK. NORTHWEST AND ALASKA FISHERIES CENTER.</b> Sensitivity of 39 Alaskan Marine Species to Cook Inlet Crude Oil and No. 2 Fuel Oil, W80-00168 5C
	<b>MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FOOD SCIENCE AND HUMAN NUTRITION.</b> Reuse of Brines in Commercial Cucumber Fermentations, W80-00128 5D		
	<b>Reuse of Fermentation Brines in the Cucumber Pickling Industry,</b> W80-00251 5D		

**ORGANIZATIONAL INDEX**  
**NATIONAL MARINE FISHERIES SERVICE, HIGHLANDS, NJ. SANDY HOOK SPORT**

- NATIONAL MARINE FISHERIES SERVICE, HIGHLANDS, NJ. SANDY HOOK SPORT FISHERIES MARINE LAB.**  
 C15+Hydrocarbons in the Sediments of the New York Bight, W80-00177 5C
- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.**  
 Great Lakes Beginning-of-Month Water Levels and Monthly Rates of Change of Storage, W80-00087 2H  
 The Use of Ecological Models of Lakes in Synthesizing Available Information and Identifying Research Needs, W80-00210 2H  
 The Examination of Ecosystem Properties of Lake Ontario Through the Use of an Ecological Model, W80-00215 2H  
 Relative Accuracy of Connecting Channel Discharge Data with Application to Great Lakes Studies, W80-00347 2E
- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, WASHINGTON, DC.**  
 Problems and Perspectives in Measuring the Social Costs of Oil Pollution, W80-00149 5C
- NATIONAL PARK SERVICE, DENVER, CO.**  
 Planning Considerations for Preservation and Use of the National Seashores, W80-00385 6E
- NATIONAL WEATHER SERVICE, SILVER SPRING, MD. OFFICE OF HYDROLOGY.**  
 Operational Use of Digital Radar in Rainfall Measurement and Prediction, W80-00337 7B
- NATIONAL WEATHER SERVICE, SILVER SPRING, MD. TECHNIQUES DEVELOPMENT LAB.; AND PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.**  
 A Model to Forecast the Motion of Oil on the Sea, W80-00182 5C
- NEPTUNE MICROFLOC, INC., CORVALLIS, OR.**  
 Improved Biological Treatment of Food Processing Wastes with Two-Stage ABF Process, W80-00133 5D
- NEW HAMPSHIRE UNIV., DURHAM. INST. OF NATURAL AND ENVIRONMENTAL RESOURCES.**  
 An Economic and Environmental Evaluation of Alternative Land Development Around Lakes, W80-00148 6B
- NEW ORLEANS UNIV., LA. CENTER FOR BIO-ORGANIC STUDIES.**  
 Chemical Characterization of Mousse and Selected Environmental Samples from the Amoco Cadiz Oil Spill, W80-00151 5C
- NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF BOTANY.**  
 A Review of Structure in Several North Carolina Salt Marsh Plants, W80-00032 2I
- NORTH CAROLINA UNIV. AT CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.**  
 Reduction of Wastes from Cucumber Pickle Processing by Use of the Controlled Culture Fermentation Process, W80-00139 5D
- NORTHEASTERN FOREST EXPERIMENT STATION, DURHAM, NH.**  
 Precipitation and Streamwater Chemistry in an Undisturbed Forested Watershed in New Hampshire, W80-00201 2K
- NORTHERN CHEYENNE RESEARCH PROJECT, LAME DEER, MT.**  
 Thermal Alteration of Groundwater Caused by Seepage from a Cooling Lake, W80-00358 5B
- OHIO UNIV., ATHENS. DEPT. OF BOTANY.**  
 Halophyte Seed Germination, W80-00326 2I
- ONTARIO MINISTRY OF AGRICULTURE AND FOOD, GUELPH. PESTICIDE RESIDUE LAB.**  
 Organochlorine Insecticides and PCB in Surficial Sediments (1968) and Sediment Cores (1976) from Lake Ontario, W80-00341 5A
- ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE. LIMNOLOGY AND TOXICITY SECTION.**  
 Depression of pH in Lakes and Streams in Central Ontario During Snowmelt, W80-00076 2H  
 Effects of Acidic Precipitation on Precambrian Freshwaters in Southern Ontario, W80-00344 5A
- ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. WATER RESOURCES BRANCH.**  
 Mass Exchange Between Hamilton Harbour and Lake Ontario, W80-00343 2H
- OREGON STATE UNIV. CORVALLIS.**  
 Local Government Response to State-Mandated Land Use Laws, W80-00369 6E
- OREGON STATE UNIV., CORVALLIS. AGRICULTURAL EXPERIMENT STATION.**  
 Thermal Conductivity of Soils as a Function of Temperature and Water Content, W80-00146 2G
- OREGON STATE UNIV., CORVALLIS. DEPT. OF MICROBIOLOGY.**  
 A Comparison of Fluorescein Dye and Antibiotic-Resistant Escherichia Coli as Indicators of Pollution in Groundwater, W80-00145 2G
- OTTAWA UNIV. (ONTARIO). DEPT. OF BIOLOGY.**  
 Response of Lake Phytoplankton Communities to In Situ Manipulations of Light Intensity and Colour, W80-00400 5A
- PENNSYLVANIA UNIV., PHILADELPHIA. DEPT. OF LANDSCAPE ARCHITECTURE.**  
 Acidification of Headwater Streams in the New Jersey Pine Barrens, W80-00354 5B
- PIMA ASSOCIATION OF GOVERNMENTS, TUCSON, AZ.**  
 Water Quality Problems of the Urban Area in an Arid Environment. Tucson, Arizona, W80-00294 5C
- PITTSBURG UNIV., PA.**  
 The Law of the Sea: A Rejoinder to Richard G. Darman, W80-00390 6E
- PITTSBURGH UNIV., PA.**  
 Water Reuse of Wastewater from a Poultry Processing Plant, W80-00142 5D
- POERTNER (HERBERT G.), BOLINGBROOK, IL.**  
 Land Use and Urban Development Affecting Stormwater Pollution and Water Quality, W80-00047 4A  
 Urban Stormwater Detention and Flow Attenuation for Pollution Control, W80-00059 4A  
 Urban Stormwater Management Problems and Solutions-Overview of a Nationwide Study, W80-00060 4A
- POLISH ACADEMY OF SCIENCES, WARSAW. DEPT. OF BIOGEOLOGY.**  
 Seasonal Changes of Phragmites Communis Trin. Part I. Growth, Morphometrics, Density and Biomass, W80-00011 2I
- PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.**  
 A Direct Solution to the Inverse Problem in Groundwater Flow, W80-00081 2F
- PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA). COLL. OF AGRICULTURAL ENGINEERING.**  
 Determination of Hydrodynamic Dispersion Coefficients Using 'Inverfc', W80-00073 5B
- PUNJAB AGRICULTURAL UNIV., LUDHIANA (INDIA). DEPT. OF CIVIL ENGINEERING.**  
 Solution of Linearized Boussinesq Equation with Stochastic Boundaries and Recharge, W80-00093 2F
- QUEEN MARY COLL., LONDON (ENGLAND). DEPT. OF ZOOLOGY AND COMPARATIVE PHYSIOLOGY.**  
 Accumulation of Cadmium by Dunalilla Tertiolecta Butcher, W80-00398 5A
- RENSELAER POLYTECHNIC INST., TROY, NY.**  
 Comparison of Diurnal Fluctuations of Dissolved Inorganic Carbon and Algal Productivity Estimates in an Oligotrophic and Mesotrophic Freshwater Environment, W80-00002 5C
- RENSELAER POLYTECHNIC INST., TROY, NY. CENTER FOR ECOLOGICAL MODELING.**  
 Modifications to the Model Cleaner Requiring Further Research, W80-00209 2H
- RESEARCH GROUP, INC., ATLANTA, GA.**  
 Planning for Environmental Management: New Directions and Initiatives, W80-00386 6E
- RESOURCES FOR THE FUTURE, INC., WASHINGTON, DC. FELLOW QUALITY OF THE ENVIRONMENT DIV.**  
 Air and Water Pollution Policy, W80-00380 6E
- RHODE ISLAND UNIV., KINGSTON. DEPT. OF OCEAN ENGINEERING.**  
 A Fishery-Oil Spill Interaction Model, W80-00150 5C  
 Oil Spill Treatment Strategy Modeling for Georges Bank, W80-00185 5C

**ORGANIZATIONAL INDEX**  
**TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF BIOLOGY.**

a Poultry	RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY. The Rates of Transport and Fates of Petroleum Hydrocarbons in a Controlled Marine Ecosystem, and a Note on Analytical Variability, W80-00169	SCIENCE AND EDUCATION ADMINISTRATION, AZ. SOUTHWEST WATERSHED RESEARCH CENTER. Geomorphic Features Affecting Transmission Loss Potential on Semiarid Watersheds, W80-00289	SHELL INTERNATIONALE PETROLEUM MIJ, THE HAGUE (NETHERLANDS). Selective Oil Spill Combat Planning for Off-shore Exploration and Production Operations in the North Sea, W80-00180
5D			5C
BROOK,			
Affecting	The Contribution of Ammonia Excreted by Zooplankton to Phytoplankton Production in Narragansett Bay, W80-00399	SCIENCE AND EDUCATION ADMINISTRATION, BOISE, ID. NORTHWEST WATERSHED RESEARCH CENTER. Comparing Water Supply Forecast Techniques, W80-00202	SHOEMAKER AND WHAM, DENVER, CO. Legal Aspects of Urban Stormwater Management, W80-00063
4A		2J	4A
ow Attenu-			
4A		2A	4A
blems and	RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). INST. FOR FRESHWATER STUDIES. Vegetation Changes in a Shallow African Lake: Response of the Vegetation to a Recent Dry Period, W80-00313	SCIENCE AND EDUCATION ADMINISTRATION, MINNEAPOLIS, MN. ST. ANTHONY FALLS HYDRAULIC LAB. Methods for Separation of Sediment from Storm Water at Construction Sites, W80-00247	SOIL CONSERVATION SERVICE, ATHENS, GA. SCS Practices as Related to Sediment and Erosion Control, W80-00054
4A		5D	4D
Study,			
4A			
GY.	ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, FLAGSTAFF, AZ. Modeling Management of Ponderosa Pine Forest Resources, W80-00228	SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. NATURAL RESOURCES ECONOMICS DIV. Rising Energy Prices, Water Demand by Periurban Agriculture, and Implications for Urban Water Supply: The Tucson Case, W80-00295	SOUTH CAROLINA UNIV., COLUMBIA. DEPT. OF GEOLOGY. Role of Dynamic Coastal Processes in the Impact and Dispersal of the Amoco Cadiz Oil Spill (March 1978) Brittany, France, W80-00154
Communis		3F	5C
ics, Density			
2I			
CIVIL	ROME UNIV. (ITALY). IST. DI FISICA. On the Green's Function of Laplace's Tidal Equation, an Application to the Northern Adriatic Sea, W80-00079	SCIENCE AND EDUCATION ADMINISTRATION, PHOENIX, AZ. WATER CONSERVATION LAB. Trickle Irrigation: Prevention of Clogging, W80-00074	SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING. Boundary Element Method for Fluid Flow, W80-00083
Problem in		5F	8B
2F			
Dispersion Co-	ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT. The Priestley-Taylor Evaporation Model Applied to a Large, Shallow Lake in the Netherlands, W80-00349	Land Treatment of Primary Sewage Effluent: Water and Energy Conservation, W80-00273	SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION, WAUKESHA. Implementation of Urban Stormwater Runoff Plans, W80-00068
5B		5D	4A
VIL			
Equation with	ROYAL RADAR ESTABLISHMENT, MALVERN (ENGLAND). A System for Real-Time Processing Transmission and Display of Radar-Derived Rainfall Data, W80-00330	Salvaging Wasted Waters for Desert-Household Gardening, W80-00285	STANLEY ASSOCIATES ENGINEERING LTD., EDMONTON (ALBERTA). Toxicity of Some Canadian Fruit and Vegetable Processing Effluents, W80-00138
2F		3D	5D
Y AND			
aliella Tertio-	RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF ENVIRONMENTAL SCIENCES. Contribution of Urban Runoff to Hydrocarbon Pollution, W80-00357	Effect of Algal Growth and Dissolved Oxygen in Redox Potentials in Soil Flooded with Secondary Sewage Effluent, W80-00286	STATE UNIV. OF NEW YORK AT ALBANY. DEPT. OF BIOLOGICAL SCIENCES. Considerations of Scale in Modeling Large Aquatic Ecosystems, W80-00205
5A		5D	2H
ST., TROY,			
ions of Dis-	SAN DIEGO STATE UNIV., CA. DEPT. OF BIOLOGY. Water Relations of Three Mangrove Species in South Florida, W80-00009	SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATER RESEARCH CENTER. Sediment Yield Equation from an Erosion Simulation Model, W80-00280	STEVENS, THOMPSON AND RUNYAN, INC., PHOENIX, AZ. Wastewater Reuse-How Viable Is It. Another Look, W80-00283
Productivity		2J	5F
Mesotrophic			
5C			
ST., TROY,	SASKATCHEWAN DEPT. OF THE ENVIRONMENT, REGINA. INLAND WATERS DIRECTORATE. Pesticides Monitoring in the Prairies of Western Canada, W80-00198	SCIENCE AND EDUCATION ADMINISTRATION, TUCSON, AZ. SOUTHWEST RANGELAND WATERSHED RESEARCH CENTER. Effectiveness of Sealing Southeastern Arizona Stock Ponds with Soda Ash, W80-00278	SUPERIOR FIBER PRODUCTS, INC., WI. Water Reuse in a Wet Process Hardboard Manufacturing Plant, W80-00250
ner Requiring		4A	5D
2H			
NTA, GA.	SAVANNAH RIVER ECOLOGY LAB., AIKEN, SC. Factors Influencing Shoot Production and Mineral Nutrient Levels in Typha Latifolia, W80-00308	Simple Time-Power Functions for Rainwater Infiltration and Runoff, W80-00279	SWIFT AND CO., OAK BROOK, IL. Removal of Suspended Solids and Algae from Aerobic Lagoon Effluent to Meet Proposed 1983 Discharge Standards to Streams, W80-00121
6E		2G	5D
INC.,		2G	
QUALITY OF	SCIENCE AND EDUCATION ADMINISTRATION, ALBANY, CA. WESTERN REGIONAL RESEARCH CENTER. Effluent Generation, Energy Use and Cost of Blanching, W80-00122	SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA. MARINE BIOLOGY RESEARCH DIV. Comparison of Hydrocarbons in Benthic Fish from Coal Oil Point and Tanner Bank, California, W80-00170	TAHAL CONSULTING ENGINEERS LTD., HAIFA (ISRAEL). Optimization of a Dam System for Recharging Runoff Water into the Ground, W80-00362
ON. DEPT.		5C	2H
Model,	Commercial Feasibility of Recovering Tomato Peeling Residuals, W80-00124	SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CA. FOUNDATION FOR OCEAN RESEARCH. The Potential Economic Uses of Halophytes, W80-00040	TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF BIOLOGY. The Interactive Effects of Temperature, Salinity, and Sublethal Exposure to Phenanthrene, a Petroleum-Derived Polycyclic Aromatic Hydrocarbon (PAH), on the Respiration Rate of Juvenile Mud Crabs, Rhithropanopeus Harrisi, W80-00172
Modeling for	Waste Reduction by Process Modification in Sweet Corn Processing, W80-00125	6C	5C
5C			

**ORGANIZATIONAL INDEX**  
**TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CIVIL ENGINEERING.**

<b>TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF CIVIL ENGINEERING.</b> Bachman Treatment Facility for Excessive Storm Flow in Sanitary Sewers, W80-00246	5D	<b>VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT; AND COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.</b> Chemical Investigations of Two Experimental Oil Spills in an Estuarine Ecosystem, Part II, W80-00186	5C	<b>WINDSOR UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.</b> Surface Loading from Pollutants in Precipitation in Southern Ontario: Some Climatic and Statistical Aspects, W80-00345	5A
<b>TEXAS AMARILLO SYSTEMS CO.</b> Control of Odors from an Anaerobic Lagoon Treating Meat Packing Wastes, W80-00119	5D	<b>VIRGINIA STATE WATER CONTROL BOARD, RICHMOND.</b> State/Local Interaction in Stormwater Management, W80-00062	4A	<b>WISCONSIN UNIV.-MADISON.</b> Development of a Synthetic Municipal Landfill Leachate, W80-00071	5E
<b>TEXAS PARKS AND WILDLIFE DEPT., AUSTIN.</b> Fishery Survey of Cedar Lakes and the Brazos and San Bernard River Estuaries, W80-00305	2H	<b>VRJE UNIV., AMSTERDAM (NETHERLANDS).</b> Theory and Application of Environmental Economics, W80-00027	6A	<b>WISCONSIN UNIV.-MILWAUKEE. DEPT. OF BOTANY.</b> Primary Productivity of Emergent Macrophytes in a Wisconsin Marsh Ecosystem, W80-00026	2I
<b>TEXAS UNIV. AT AUSTIN. PLANT ECOLOGY RESEARCH LAB.</b> Salt Tolerance of Mangroves and Submerged Aquatic Plants, W80-00033	2I	<b>VRJE UNIV., AMSTERDAM (NETHERLANDS). BIOLOGICAL LAB.</b> The Influence of Salinity, Inundation and Temperature on the Germination of Some Halophytes and Non-Halophytes, W80-00022	2I	<b>WOODS HOLE OCEANOGRAPHIC INST., MA.</b> Nitrogen Fixation by Rhizosphere and Free-Living Bacteria in Salt Marsh Sediments, W80-00016	2I
<b>TOKYO UNIV. (JAPAN). MUSEUM.</b> Survey of the Effects of the Seto Inland Sea Oil Spill in 1974, W80-00187	5C	<b>WASHINGTON STATE DEPT. OF ECOLOGY, OLYMPIA.</b> Recovery of Soluble Serum Proteins from Meat Industry Wastes, W80-00132	5D	<b>WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.</b> Winter Circulation in the Western Gulf of Maine: Part 2. Current and Pressure Observations, W80-00069	2L
<b>TORONTO UNIV. (ONTARIO).</b> Relationship of Hydrocarbon Solubility to Toxicity in Algae and Cellular Membrane Effects, W80-00167	5C	<b>WASHINGTON STATE UNIV., PULLMAN. DEPT. OF MATERIALS SCIENCE AND ENGINEERING.</b> Immobilization of Hazardous Residuals by Encapsulation, W80-00256	5D	<b>WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA. JOINT PROGRAM IN BIOLOGICAL OCEANOGRAPHY.</b> Pyrite: Its Rapid Formation in a Salt Marsh and Its Importance to Ecosystem Metabolism, W80-00311	2K
<b>TORONTO UNIV. (ONTARIO). DEPT. OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY.</b> Behavior and Effectiveness of Dispersants at Sea and at Shorelines, W80-00160	5C	<b>WASHINGTON UNIV., SEATTLE. SEA GRANT PROGRAM.</b> Preliminary Evaluation of Anaerobic Sludge Digestion for the Tuna Processing Industry, W80-00127	5E	<b>WOODWARD-CLYDE CONSULTANTS, SAN FRANCISCO, CA.</b> Decision Criteria for the Chemical Dispersion of Oil Spills, W80-00161	5C
<b>TORONTO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.</b> Formulation and Testing of a New Water Quality Index, W80-00304	7B	<b>WATER RESOURCES BOARD, READING (ENGLAND).</b> Design of the Dee Telemetry System with Computer Acquisition of Data, W80-00331	7B	<b>WORLD METEOROLOGICAL ORGANIZATION, GENEVA (SWITZERLAND).</b> Field Projects Executed by WMO on Flood Forecasting and Warning, Using Radar and/or Integrated Telemetry Systems. W80-00338	2E
<b>UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES. INST. FOR MARINE AND COASTAL STUDIES.</b> Distribution of Tar and Relationship to Changes in Intertidal Organisms on Sandy Beaches in Southern California, W80-00173	5B	<b>WATERLOO UNIV. (ONTARIO). DEPT. OF EARTH SCIENCES.</b> Exact Aquitard Response Functions for Multiple Aquifer Mechanics, W80-00356	2F		
<b>UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.</b> Real-Time Flood Forecasting for Southern California, W80-00340	2E	<b>WATERLOO UNIV. RESEARCH INST. (ONTARIO).</b> BOD/TOC Correlations and Their Application to Water Quality Evaluation, W80-00353	5D		
<b>UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF.</b> The Anglo-French Continental Shelf Case, W80-00366	6E	<b>WELSH NATIONAL WATER DEVELOPMENT AUTHORITY, CARDIFF (WALES).</b> Installation and Operation of the Dee Telemetry System, W80-00332	7B		
<b>UTAH STATE UNIV., LOGAN. WATERSHED SCIENCE UNIT.</b> Effects of Rainfall Intensity on Runoff Curve Numbers, W80-00276	2E	<b>WELSH NATIONAL WATER DEVELOPMENT AUTHORITY, CHESTER (ENGLAND).</b> Control Rules for Long and Short Term Objectives, W80-00335	2E		
<b>VANDERBILT UNIV., NASHVILLE, TN. DEPT. OF ENVIRONMENTAL AND WATER RESOURCES.</b> Interfacial Stability in Channel Flow, W80-00297	2E	<b>WESTERN MICHIGAN UNIV., KALAMAZOO.</b> International Environmental Implications of Soviet Development of the Volga River, W80-00368	6E		
<b>VIENNA UNIV. (AUSTRIA). PFLANZENPHYSIOLOGISCHES INST.</b> Role of Carbohydrate in Halophytes of the Region of Neusiedler Lake, Austria, (In German), W80-00021	2I				

# ACCESSION NUMBER INDEX

OF

precipitation  
and Statisti-

5A

al Landfill

5E

DEPT. OF

macrophytes

2I

INST.,

and Free-

nts,

2I

n Gulf of

re Observa-

2L

AM IN

Marsh and

alism,

2K

TS, SAN

Dispersion of

5C

ZERLAND).

O on Flood

adar and/or

2E

W80-00001 6D  
W80-00002 5C  
W80-00003 6G  
W80-00004 6G  
W80-00005 5G  
W80-00006 2I  
W80-00007 2H  
W80-00008 5D  
W80-00009 2I  
W80-00010 2I  
W80-00011 2I  
W80-00012 2J  
W80-00013 5C  
W80-00014 2I  
W80-00015 6G  
W80-00016 2I  
W80-00017 2I  
W80-00018 2I  
W80-00019 2E  
W80-00020 5B  
W80-00021 2I  
W80-00022 2I  
W80-00023 2I  
W80-00024 2I  
W80-00025 5C  
W80-00026 2I  
W80-00027 6A  
W80-00028 2I  
W80-00029 2I  
W80-00030 2A  
W80-00031 2I  
W80-00032 2I  
W80-00033 2I  
W80-00034 2I  
W80-00035 2L  
W80-00036 2I  
W80-00037 7B  
W80-00038 2I  
W80-00039 2I  
W80-00040 6C  
W80-00041 2I  
W80-00042 8D  
W80-00043 4A  
W80-00044 4A  
W80-00045 4A  
W80-00046 4A  
W80-00047 4A  
W80-00048 4A  
W80-00049 4C  
W80-00050 4C  
W80-00051 4A  
W80-00052 4C  
W80-00053 4D  
W80-00054 4D  
W80-00055 4A  
W80-00056 4A  
W80-00057 4A  
W80-00058 4A  
W80-00059 4A  
W80-00060 4A  
W80-00061 4D  
W80-00062 4A  
W80-00063 4A  
W80-00064 4A  
W80-00065 4A  
W80-00066 4A  
W80-00067 4A  
W80-00068 4A  
W80-00069 2L  
W80-00070 2F  
W80-00071 5E  
W80-00072 2C  
W80-00073 5B  
W80-00074 5F  
W80-00075 2K  
W80-00076 2H  
W80-00077 2E  
W80-00078 5B  
W80-00079 2L  
W80-00080 2C  
W80-00081 2F  
W80-00082 5B  
W80-00083 8B  
W80-00084 2C

W80-00085 2L  
W80-00086 5A  
W80-00087 2H  
W80-00088 2K  
W80-00089 2F  
W80-00090 2G  
W80-00091 2G  
W80-00092 2B  
W80-00093 2F  
W80-00094 2F  
W80-00095 2F  
W80-00096 2F  
W80-00097 5D  
W80-00098 5D  
W80-00099 5D  
W80-00100 5D  
W80-00101 5D  
W80-00102 5D  
W80-00103 5D  
W80-00104 5D  
W80-00105 5D  
W80-00106 5D  
W80-00107 5A  
W80-00108 5D  
W80-00109 5D  
W80-00110 2G  
W80-00111 5D  
W80-00112 5D  
W80-00113 5D  
W80-00114 5D  
W80-00115 5D  
W80-00116 5D  
W80-00117 6E  
W80-00118 5D  
W80-00119 5D  
W80-00120 5D  
W80-00121 5D  
W80-00122 5D  
W80-00123 5D  
W80-00124 5D  
W80-00125 3E  
W80-00126 5D  
W80-00127 5E  
W80-00128 5D  
W80-00129 5D  
W80-00130 5D  
W80-00131 5D  
W80-00132 5D  
W80-00133 5D  
W80-00134 5D  
W80-00135 5D  
W80-00136 5D  
W80-00137 5D  
W80-00138 5D  
W80-00139 5D  
W80-00140 5D  
W80-00141 5D  
W80-00142 5D  
W80-00143 5D  
W80-00144 5D  
W80-00145 2G  
W80-00146 2G  
W80-00147 6A  
W80-00148 6B  
W80-00149 5C  
W80-00150 5C  
W80-00151 5C  
W80-00152 5C  
W80-00153 5C  
W80-00154 5C  
W80-00155 5C  
W80-00156 5C  
W80-00157 5B  
W80-00158 5C  
W80-00159 5C  
W80-00160 5C  
W80-00161 5C  
W80-00162 5C  
W80-00163 5C  
W80-00164 5C  
W80-00165 5C  
W80-00166 5C  
W80-00167 5C  
W80-00168 5C

W80-00169 5C  
W80-00170 5C  
W80-00171 5C  
W80-00172 5C  
W80-00173 5B  
W80-00174 5C  
W80-00175 5C  
W80-00176 5C  
W80-00177 5C  
W80-00178 5C  
W80-00179 5C  
W80-00180 5C  
W80-00181 5C  
W80-00182 5C  
W80-00183 5C  
W80-00184 5C  
W80-00185 5C  
W80-00186 5C  
W80-00187 5C  
W80-00188 5C  
W80-00189 5C  
W80-00190 5C  
W80-00191 5C  
W80-00192 8I  
W80-00193 5A  
W80-00194 5C  
W80-00195 4A  
W80-00196 4A  
W80-00197 2H  
W80-00198 5C  
W80-00199 2A  
W80-00200 2A  
W80-00201 2K  
W80-00202 2A  
W80-00203 6D  
W80-00204 2H  
W80-00205 2H  
W80-00206 2H  
W80-00207 2H  
W80-00208 2H  
W80-00209 2H  
W80-00210 2H  
W80-00211 2H  
W80-00212 2H  
W80-00213 6A  
W80-00214 2H  
W80-00215 2H  
W80-00216 5A  
W80-00217 1A  
W80-00218 1A  
W80-00219 1A  
W80-00220 2J  
W80-00221 1B  
W80-00222 5B  
W80-00223 6G  
W80-00224 7B  
W80-00225 2E  
W80-00226 2F  
W80-00227 2F  
W80-00228 2A  
W80-00229 7B  
W80-00230 2F  
W80-00231 8I  
W80-00232 2K  
W80-00233 1A  
W80-00234 7C  
W80-00235 7C  
W80-00236 7C  
W80-00237 5C  
W80-00238 2A  
W80-00239 7C  
W80-00240 7C  
W80-00241 6A  
W80-00242 6E  
W80-00243 8G  
W80-00244 5D  
W80-00245 5D  
W80-00246 5D  
W80-00247 5D  
W80-00248 5B  
W80-00249 6B  
W80-00250 5D  
W80-00251 5D  
W80-00252 2F

W80-00253 5D  
W80-00254 5C  
W80-00255 5D  
W80-00256 5D  
W80-00257 5D  
W80-00258 5D  
W80-00259 5D  
W80-00260 5D  
W80-00261 5D  
W80-00262 5E  
W80-00263 5E  
W80-00264 5D  
W80-00265 5D  
W80-00266 5D  
W80-00267 5D  
W80-00268 5F  
W80-00269 4B  
W80-00270 6B  
W80-00271 6E  
W80-00272 5D  
W80-00273 5D  
W80-00274 5F  
W80-00275 3B  
W80-00276 2E  
W80-00277 8A  
W80-00278 4A  
W80-00279 2G  
W80-00280 2J  
W80-00281 2E  
W80-00282 5B  
W80-00283 5F  
W80-00284 3C  
W80-00285 3D  
W80-00286 5D  
W80-00287 5C  
W80-00288 5B  
W80-00289 2J  
W80-00290 3B  
W80-00291 2G  
W80-00292 2C  
W80-00293 6E  
W80-00294 5C  
W80-00295 3F  
W80-00296 6A  
W80-00297 2E  
W80-00298 2I  
W80-00299 2I  
W80-00300 2L  
W80-00301 2L  
W80-00302 2L  
W80-00303 2I  
W80-00304 7B  
W80-00305 2H  
W80-00306 5A  
W80-00307 2I  
W80-00308 2I  
W80-00309 2I  
W80-00310 2B  
W80-00311 2K  
W80-00312 5C  
W80-00313 2H  
W80-00314 2I  
W80-00315 2H  
W80-00316 6A  
W80-00317 6E  
W80-00318 6B  
W80-00319 2I  
W80-00320 2G  
W80-00321 2I  
W80-00322 2I  
W80-00323 2I  
W80-00324 2G  
W80-00325 2I  
W80-00326 2I  
W80-00327 2K  
W80-00328 4C  
W80-00329 7B  
W80-00330 7B  
W80-00331 7B  
W80-00332 7B  
W80-00333 7B  
W80-00334 2E  
W80-00335 2E  
W80-00336 2B

W80-00337 7B  
 W80-00338 2E  
 W80-00339 2E  
 W80-00340 2E  
 W80-00341 5A  
 W80-00342 6A  
 W80-00343 2H  
 W80-00344 5A  
 W80-00345 5A  
 W80-00346 6B  
 W80-00347 2E  
 W80-00348 2J  
 W80-00349 2D  
 W80-00350 2B  
 W80-00351 2D  
 W80-00352 2L  
 W80-00353 5D  
 W80-00354 5B  
 W80-00355 2L  
 W80-00356 2F  
 W80-00357 5B  
 W80-00358 5B  
 W80-00359 5B  
 W80-00360 6E  
 W80-00361 6A  
 W80-00362 4B  
 W80-00363 6E  
 W80-00364 6E  
 W80-00365 6E  
 W80-00366 6E  
 W80-00367 6E  
 W80-00368 6E  
 W80-00369 6E  
 W80-00370 6E  
 W80-00371 6E  
 W80-00372 6E  
 W80-00373 6E  
 W80-00374 6E  
 W80-00375 6E  
 W80-00376 6E  
 W80-00377 6E  
 W80-00378 6E  
 W80-00379 6E  
 W80-00380 6E  
 W80-00381 6E  
 W80-00382 6E  
 W80-00383 6E  
 W80-00384 6E  
 W80-00385 6E  
 W80-00386 6E  
 W80-00387 6E  
 W80-00388 6E  
 W80-00389 6E  
 W80-00390 6E  
 W80-00391 5A  
 W80-00392 5C  
 W80-00393 2F  
 W80-00394 5A  
 W80-00395 5A  
 W80-00396 5B  
 W80-00397 6A  
 W80-00398 5A  
 W80-00399 5A  
 W80-00400 5A

# ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
A. CENTERS OF COMPETENCE		
Cornell University, Policy Models for Water Resources Systems	W80-00027 00147--00148 00202--00216 00228, 00252 00254, 00304 00312, 00318 00342, 00346 00361--00362 00393, 00397	30
Franklin Institute (FIRL), Municipal and Industrial Wastewater Treatment Technology	W80-00043--00068 00097--00109 00111--00144 00242--00251 00253 00255--00268	98
Illinois State Water Survey, Hydrology	W80-00069--00096 00145--00146 00192, 00297 00329--00341 00343--00345 00347--00359	61
University of Arizona, Arid Land Water Resources	W80-00269--00296	28
University of Florida, Eastern U. S. Water Law	W80-00360 00363--00390	29
B. STATE WATER RESOURCES RESEARCH INSTITUTES	W80-00001--00002 00193	3
C. OTHER		
Environment Canada (WATDOC)	W80-00194--00200	7
Environmental Information Services, Inc. (Effects of Pollutants on Aquatic Life)	W80-00391--00392 00394--00396 00398--00400	8

# ABSTRACT SOURCES

SOURCE	ACCESSION NUMBER	TOTAL
C. OTHER (CONTINUED)		
Forest Service (USDA)	W80-00201	1
Ocean Engineering Info. Service (Patents)	W80-00005, 00008 00030, 00110	4
Ocean Engineering Info. Service (Outer Continental Shelf)	W80-00149--00191	43
U.S. Geological Survey	W80-00217--00227 00229--00241	24
University of Massachusetts (Wetlands)	W80-00003--00004 00006--00007 00009--00026 00028--00029 00031--00042 00298--00303 00305--00311 00313--00317 00319--00328	64

TOTAL

1

4

43

24

64